THE WHITMAN COMPANIES, INC.

Setting the Standard in Environmental Engineering & Management

FIRST AMENDED TECHNICAL MEMORANDUM FOR DEVELOPMENT AND SCREENING OF ALTERNATIVES FOR SITE REMEDIATION

FOR
ROCKAWAY BOROUGH WELL FIELD SITE
OPERABLE UNIT #3
FOR PROPERTY OF
KLOCKNER & KLOCKNER
ROCKAWAY BOROUGH, NEW JERSEY

SUBMITTED TO
USEPA-REGION II
EMERGENCY & REMEDIAL RESPONSE DIVISION
NEW YORK, NEW YORK

SUBMITTED BY
THE WHITMAN COMPANIES, INC.
ON BEHALF OF KLOCKNER & KLOCKNER

IN ACCORDANCE WITH
ADMINISTRATIVE ORDER ON CONSENT
INDEX NO. II-CERCLA-95-0104

MARCH 2005

MICHAEL N. METLITZ
PROJECT MANAGER

IRA L. WHITMAN, PH.D., P.E.
PRINCIPAL CONSULTANT

116 Tices Lane, Unit B-1, East Brunswick, NJ 08816
www.whitmanco.com

THE
WHITMAN
COMPANIES, INC.

Corporate Headquarters
116 Tices Lane, Unit B-1
East Brunswick, NJ 08816

Tel: 732.390.5858 • Fax: 732.390.9496
Email: whitman@whitmanco.com
Internet: www.whitmanco.com

September 16, 2004

Chief, New Jersey Superfund Branch I
Emergency & Remedial Response Division
U.S. Environmental Protection Agency, Region II
290 Broadway, Floor 19
New York, NY 10007

Attn: Brian Quinn, Project Manager

RE: First Amended Technical Memorandum
Klockner & Klockner
Rockaway Borough Wellfield Superfund Site
Administrative Order on Consent ("AOC")
Index No. II-CERCLA-95-0104
Whitman Project #95-03-02

Dear Mr. Quinn:

In compliance with Paragraph 34 of the above AOC, Task VIII of the Statement of Work and the U.S. Environmental Protection Agency's (EPA's) January 20, 2005 comments concerning Klockner and Klockner's September 16, 2004 Technical Memorandum for Development and Screening of Alternatives for Site Remediation for the above referenced site, enclosed are four copies of the First Amended Technical Memorandum for Development and Screening of Alternatives for Site Remediation (Technical Memorandum). The Technical Memorandum incorporates EPA's January 20, 2005 comments.

If you have any questions or comments concerning the Technical Memorandum, please contact me at (732) 390-5858.

Very truly yours,

Michael N. Metlitz
Senior Project Manager

Bharti Ujjani, C.I.H.
Vice President Environmental Health & Safety

MNM/
Enclosure
cc: Frances Zizila, Assistant Regional Counsel, EPA
Dan Klockner, Klockner & Klockner
Jennifer Peterson, Esq., Riker Danzig, Scherer, Hyland & Perretti
Donna Gaffigan, NJDEP

307214

FIRST AMENDED TECHNICAL MEMORANDUM FOR DEVELOPMENT AND SCREENING OF ALTERNATIVES FOR SITE REMEDIATION ROCKAWAY BOROUGH WELL FIELD SITE OPERABLE UNIT #3 FOR PROPERTY OF KLOCKNER & KLOCKNER ROCKAWAY BOROUGH, NEW JERSEY

Table of Contents

307216

TABLES

FIGURES

ATTACHMENTS

307218

FIRST AMENDED TECHNICAL MEMORANDUM FOR DEVELOPMENT AND SCREENING OF ALTERNATIVES FOR SITE REMEDIATION ROCKAWAY BOROUGH WELL FIELD SITE OPERABLE UNIT #3 FOR PROPERTY OF KLOCKNER & KLOCKNER ROCKAWAY BOROUGH, NEW JERSEY

1.0 INTRODUCTION

This First Amended Technical Memorandum for Development and Screening of Alternatives for Site Remediation (DSASR) has been prepared by The Whitman Companies, Inc. (Whitman) on behalf of Klockner & Klockner (Klockner) in accordance with Chapter VIII, Paragraph 34 of the Administrative Order on Consent (AOC) entered into by Klockner and the United States Environmental Protection Agency (EPA), and Task VIII of the Statement of Work (SOW) (USEPA, 1995). This DSASR incorporates EPA's January 20, 2005 comments (Attachment 2) on Klockner's September 16, 2004 DSASR.

1.1 Purpose of Report

The purpose of this DSASR is to:

- Describe the process employed in the development of the remedial action objectives and screening of remedial actions for the Rockaway Borough Wellfield Site (Site) - Operable Unit #3 at Block 5, Lots 1 and 6, and Block 7, Lots 7 and 8, in the Borough of Rockaway (Klockner Property). Operable Unit #3 consists of the soil component of the response activities associated with source areas contributing to ground water contamination at the Site.

- Identify the remedial alternatives available for the remedial action for soil contamination, due to the presence of Trichloroethylene (TCE) and Tetrachloroethylene (PCE) and Lead.

- Identify potential treatment technologies and containment/disposal requirements for residual waste.

- Screen various remedial technologies for remediation based on the implementability at the Klockner Property.

- Identification of candidate remedial process options for the soil component of the site remedy to assess under the Treatability and Feasibility Study.

307219

1.2 Report Organization

The DSASR is organized as follows:

- **Section 1** - Introduction
- **Section 2** – Site background
- **Section 3** – CERCLA criteria used to evaluate remediation alternatives
- **Section 4** – Development of Remedial Action Objectives
- **Section 5** – Development and screening of remedial technologies and process options
- **Section 6** – Initial screening of process options
- **Section 7** – Detailed analysis of alternatives
- **Section 8** – Conclusions
- **Section 9** – References

2.0 SITE BACKGROUND

2.1 Klockner Property Location

The Klockner Property is located at the intersection of Stickle Avenue and Elm Street in the north end of the Borough of Rockaway in Morris County, New Jersey. The Klockner Property is a portion of the Rockaway Borough Well Field Site (Site), which itself encompasses approximately 2.1 square miles. The Rockaway Borough well field is located approximately 600 feet southwest of the Klockner Property. See Figure 1 for the Klockner Property location on a U.S.G.S. Dover, N.J. quadrangle. A site map of the Klockner Property is included as Figure 2.

The Klockner Property consists of two separate properties. The first property is located north of Stickle Avenue and is currently owned by Klockner. This portion of the Klockner Property consists of Block 5, Lots 1 and 6, and is referred to as the "Building 12 Property."

The second portion of the Klockner Property is located south of Stickle Avenue and consists of Block 7, Lots 7 and 8, and is referred to as the "Building 13 Property." Lot 7 is currently owned by Norman Iverson and operated by F.G. Clover Co. Lot 8 is currently owned by Klockner and is used as parking for Building 12 Property tenants.

The Building 12 Property consists of 1.34 acres. The majority (approximately 93%) of the Building 12 Property is covered by building structures and pavement. The building structures consist of approximately 50,000 square feet of one and two story space used for manufacturing, office space and storage. The Building 12 Property is bordered to the south by Stickle Avenue, to the east by Oak Street and residential housing, to the north by Ford Road and to the west by Elm Street.

Lot 7 of the Building 13 Property consists of approximately 1.07 acres, and Lot 8 consists of approximately 0.5 acres. There are two building structures present on Lot 7 of the Building 13 Property. The building coverage of the Building 13 Property is approximately 12,400 square feet. Approximately 50% of the Building 13 Property is covered by building structures and pavement. Lot 8 is a partially paved area with no structures. The Building 13 Property is bordered to the north by Stickle Avenue, to the west by Elm Street, to the south by residential property and to the east by a railroad line.

2.2 Site History

The Site is a municipal well field that serves approximately 10,000 people. The Rockaway Borough's three water supply wells (#1, 5 and 6) draw water from an unconsolidated glacial aquifer from a depth ranging from 54 to 84 feet below grade. The supply wells are located off of Union Street and are southwest of the Klockner Property.

Contamination of the groundwater at the Site was first discovered in 1979. The primary contaminants identified were Trichloroethylene (TCE) and Tetrachloroethylene (PCE). Several inorganic contaminants, including Chromium, Lead and Nickel, also were identified. The Site was placed on the EPA's National Priorities List of Superfund sites in December 1982.

Following discovery of ground water contamination at the Site, the New Jersey Department of Environmental Protection (NJDEP) conducted an RI/FS (SAIC, 1986), which was known as Operable Unit 1 (OU1), and EPA conducted a second RI/FS (ICF, 1991a and b), which was known as Operable Unit 2 (OU2). Through these studies, the Klockner Property was identified as one of the potential source areas of the Site contamination and was designated as the Operable Unit #3 by EPA.

The investigation of soil and ground water contamination was initiated at the Building 12 portion of the Klockner Property in 1986 under New Jersey's Environmental Cleanup Responsibility Act (ECRA). The ECRA investigation was conducted under oversight of the NJDEP. Soil and ground water contamination were detected, consisting primarily of chlorinated volatile organic compounds. Klockner withdrew from the ECRA program in 1990 but continued to investigate the source of TCE and PCE contamination in soil through January 1992.

The remediation of the contamination originating from the Klockner Property area already in the ground water and saturated zone is being addressed by Cordant Technologies, Inc. (previously Thiokol Corp.) pursuant to a 1994 Consent Decree entered into between it and EPA. Under the 1995 AOC and SOW, Klockner agreed to conduct an RI/FS addressing the source(s) of the ground water contamination present in the unsaturated zone at the Klockner Property. The unsaturated zone was identified as the area above the water table as measured in the Site monitoring wells on January 16, 1991 (Attachment 1). The remedial investigation activities conducted at the Klockner Property by Klockner were reported in the May 2004 Final Remedial Investigation Report.

2.3 Development and Screening of Alternatives for Site Remediation

The development and screening of alternatives for site remediation is conducted in accordance with the requirements of the EPA document Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA.

3.0 CERCLA CRITERIA USED TO EVALUATE REMEDIATION ALTERNATIVES

The nine evaluation criteria employed for the selection of the remedial alternatives include:

Category	Criteria
Threshold Criteria	1. To provide protection of human health and the environment 2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
Balancing Criteria	3. Offer Long term effectiveness 4. Evaluation of how the remedy acts to reduce the toxicity, mobility, and volume of the contamination 5. Short term effectiveness 6. Implementability 7. Cost Effectiveness
Regulatory Agency and Community Criteria	8. Assessment of state acceptance 9. Community acceptance

4.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

4.1 Cleanup Criteria for TCE, PCE and Lead

Soil is the only media being evaluated under this DSASR. The soil contaminants of concern and proposed cleanup criteria are presented below. 307222

4.1.1 Contaminants of Concern Identified on Subject Site

The contaminants of concern identified in the soil at the Klockner Property include:

- Trichloroethylene (TCE)
- Perchloroethylene (PCE)
- Lead

The highest concentration of Lead detected in soil was of 841 mg/kg at a depth of 0-0.5 feet. The highest concentration of TCE detected in soil was 90 mg/Kg at a depth of 1-1.5 feet. The highest concentration of PCE detected in soil was 23.7 mg/Kg at a depth of 2-2.5 feet in the Quonset Hut location of the Klockner Property.

4.1.2 Cleanup Criteria

The following provides information concerning the nature and extent of contamination, Applicable or Relevant and Appropriate Requirements (ARARs), and EPA and New Jersey State cleanup criteria/standards. The Risk Assessment conducted by EPA and included in the May 2004 Final Remedial Investigation Report indicated that the Lead, TCE and PCE concentrations present in the soils at the Klockner Property were not a concern with respect to the current property use. The summary section of the EPA's Risk Assessment is provided below:

The results of the hazard and risk calculations for the Klockner and Klockner property indicate that the current noncancer hazards and cancer risks for an adult worker and adolescent intermittent visitor from soil exposure are below or within EPA's acceptable values. This assessment only accounted for the hazards and risks associated with soil exposure, so the actual risk at the site may be higher when other contaminated medium are included. The potential future uses of the site as a recreational park visitor yielded hazards and risks for an adult and child population for soil exposure that were below or within EPA's acceptable values. Another potential, although unlikely, future use as a residential area indicated that the hazards and risks for an adult resident were below or within EPA's acceptable values. However, the noncancer hazard for a child resident, driven by trichloroethene and iron, exceeded EPA's acceptable value. The concentrations of trichloroethene and tetrachloroethene detected in the soil exceed New Jersey's criteria for soil contamination due to potential to contaminate groundwater. Thus, even though the hazards and risks for soil exposure are below or within acceptable EPA values, a remedial action may still be warranted.

The purpose of ARARs is to ensure that response actions are consistent with other pertinent federal and state requirements for public health and environmental protection that legally would be required or applicable in sufficiently similar circumstances to those encountered at hazardous waste sites. In addition, the Superfund Amendments and Reauthorization Act (SARA) requires that state ARARs be considered during the assembly of remedial alternatives if they are more stringent than Federal requirements. EPA also has indicated that "other" criteria, advisories, and guidelines must be considered in evaluating remedial alternatives. ARARs are categorized, using current EPA practice, as contaminant-specific, location-specific, and action-specific.

A list of potential Federal and State of New Jersey ARARs for the site was analyzed and considered to determine the cleanup criteria for the Site.

NJDEP's May 12, 1999 Soil Cleanup Criteria (NJSCC) guidance document contains guidance criteria that are "to be considered" (TBC). The NJSCC include impact to ground water soil cleanup criteria (NJIGWSCC), residential direct contact soil cleanup criteria (NJRDCSCC) and nonresidential direct contact soil cleanup criteria (NJNRDCSCC). These three types of soil cleanup criteria are TBC when evaluating remedial alternatives for the Klockner Property. NJDEP requires remediation of soil contamination that exceeds the unrestricted use criteria. The most predominant contaminants detected in the soil at the Klockner Property above the most stringent NJSCC included TCE, PCE and Lead as summarized below.

Table I
Relevant Cleanup Levels for Site Contaminants

Contaminant	Federal Standard (EPA)	NJIGWSCC	NJRDCSCC	Proposed Cleanup Concentration	Maximum Concentration Found
TCE	N/A	1 mg/kg	23 mg/kg, residential	1 mg/kg for impact to ground water	90 mg/kg
PCE	N/A	1 mg/kg	4 mg/kg, residential	1 mg/kg for impact to ground water	23.7 mg/kg
Lead	1250 mg/kg Industrial site	None	400 mg/kg	400 mg/kg for residential per NJRDCSCC	841 mg/kg

4.2 Media to Which Remedial Action Applies

Based on the 1995 AOC between EPA and Klockner & Klockner, this Technical Memorandum for Development and Screening of Alternatives for Site Remediation is focused on the remedial actions that apply to soil media above the water table. The ground water remediation is being addressed by Cordant Technologies, Inc.

307224

4.3 Identification of Volumes or Areas of Media

Volumes and location of soil to which remedial action applies is as follows:

4.3.1 TCE and PCE Contamination

Building 12 Property:

The primary Chlorinated Volatile Organic Compound (CVOC) detected above its NJSCC at the Building 12 Property was TCE. Except for the North Drum Storage Area, the other areas where CVOCs were detected were further investigated as part of the Alleyway Area. The sampling activities conducted have delineated the vertical and horizontal extent of the CVOC soil contamination at the Building 12 Property. The CVOC soil contamination generally extends to a depth of less than 5 to 7 feet. The TCE contaminated area exceeding the NJSCC is irregularly shaped and is approximately 215 feet across its north-south axis and varies in width from approximately 50 feet to 155 feet from east to west. The estimated quantity of soil exceeding the most stringent NJSCC for TCE is approximately 4,090 cubic yards. The approximate horizontal and vertical extent of the TCE soil contamination with respect to the NJSCC is included in Figures 3, 5 and 6.

PCE was detected in the soil samples collected at the Quonset Hut, Sump and southwestern portion of the area between the Alleyway and Degreaser Pit. Based on comparison to the TCE concentrations throughout these areas, PCE is considered a secondary contaminant. The PCE contaminated areas exceeding the NJSCC are irregular in shape and are approximately 3,375 square feet by 5 feet deep (625 cubic yards) (Quonset Hut/Sump) and approximately 4,200 square feet by 5 feet deep (778 cubic yards) (Southwestern Portion). The quantitation limits (range from 1.46 to 3.07 mg/kg) for some of the samples collected in the Scale Room and the area between the Alleyway and Degreaser Pit (Samples SSSR-2, SSSR-3, SSAW-2, SSAW-3, SSAW-4, SSAW-9, SSAW-10) were just above the NJIGWSCC of 1 mg/kg. The TCE concentrations in the noted samples all exceeded 19 mg/kg, identifying the areas for remedial activities. The higher TCE concentrations resulted in the need for the laboratory to dilute the affected samples. Such a dilution resulted in the increase of the quantitation limits for PCE to above 1 mg/kg. Therefore, if the PCE was present above 1 mg/kg and less than the quantitation limit, it is highly likely that it would have been detected below the quantitation limit and reported as such. Therefore, the fact that the quantitation limits for the PCE in the affected samples were just above its NJIGWSCC is not a concern with respect to defining the extent of PCE contamination or identifying remedial activities for the Site. The vertical and horizontal extent of the PCE affected areas has been delineated. The approximate horizontal and vertical extent of the PCE soil contamination with respect to the NJSCC is included in Figures 10, 11 and 12.

307225

Building 13 Property:

The results of the sampling activities identified one (1) area where PCE soil contamination was detected above the current NJIGWSCC of 1 mg/kg and NJRDCSCC of 4 mg/kg. This area is identified as the Fence Area. The highest PCE concentration detected in this area was 4.28 mg/kg. The PCE contamination has been delineated both horizontally and vertically (Figures 7 and 8) in this area, and covers an area of approximately 40 feet by 20 feet by less than 5 feet deep (150 cubic yards).

4.3.2 Lead Contamination

Building 12 Property:

Site investigation studies show that the Lead contamination is confined to an area of 20'x 18' along the Northeast property boundary line of the Building 12 Property.

Lead contamination was detected above the NJRDCSCC at the former Drum Storage Shed Area located just northeast of the Alleyway. The sampling activities conducted have vertically and horizontally delineated the Lead concentrations below the NJRDCSCC (Figure 9). At the most, the area of Lead concentrations exceeding the current NJRDCSCC of 400 mg/kg is 20 feet by 18 feet by 2 feet deep (27 cubic yards).

5.0 <u>DEVELOPMENT AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS</u>

5.1 Introduction

Process options are remedial technologies and/or techniques that can be used either individually or in combination to control risks to human health and the environment and satisfy the remedial action objectives unique to each contaminated site. The initial list of remedial technologies and process options considered in the Final Remedial Investigation Report was developed by Klockner.

This section presents the remedial technologies and process options that could potentially be used to achieve the remedial action objectives. Section 6.0 screens out the process options that are impractical given the site-specific conditions; and Section 7.0 assembles the surviving process options into remedial alternatives deemed capable of achieving the remedial action objectives. The remedial alternatives themselves are then evaluated and screened under the

307226

criteria discussed in Section 3. The surviving remedial alternatives are further evaluated in Section 8.0.

5.2 Identification of Remedial Technologies and Process Options Potentially Available

The following remedial technologies and process options were identified as potentially appropriate for remediation of the contaminated soil at the site. The remedial action applies to one inorganic contaminant (Lead) and two volatile organic compounds (TCE and PCE). The Lead contamination is confined to one area along the Northeast border of the Building 12 Property.

5.2.1 Remedial Technologies and Process Options for TCE and PCE

The following is a list of possible remedial technologies for remediating the TCE and PCE soil contamination at the Klockner Property. These process options and how they fared in the initial screening are summarized in Section 6.0.

1. General Methods of Controlling or Addressing Contamination
   - No Action
   - Monitored Attenuation
   - Institutional Controls
   - Containment

2. Removal/Excavation and Ex-situ Treatment
   - Off-site Disposal of Contaminated Soil
   - On-site Incineration
   - On-site Thermal Desorption
   - On-site Soil Aeration

3. In-situ Treatment
   - Soil Vapor Extraction (SVE)
   - In situ Thermal Treatment/ with SVE
     - Steam Injection with SVE
     - Hot Air Injection with SVE
     - Electrical Resistance Heating with SVE
     - Radio Frequency Heating with SVE
   - Bioremediation
   - Partial Phytoremediation

4. Chemical Treatment
   - Ozone Injection
   - Hydrogen Peroxide Injection

307227

5.2.2 Remedial Technologies and Process Options for Lead

The following is a list of possible remediation alternatives technologies for remediating the Lead soil contamination at the Klockner Property. These process options and how they fared in the initial screening are summarized in Section 6.0.

1. General Methods of Controlling or Addressing Contamination
   - No Action
   - Institutional Controls
   - Containment

2. Removal/Excavation and Ex-situ Treatment
   - Off-site disposal of contaminated soil
   - Soil Washing

3. In-situ Treatment
   - Phytoremediation

5.2.3 Treatment Location

The following are the possible ex-situ treatment locations for excavated material.

- Building 12 parking lot
- Building 13 parking lot

5.2.4 Screening Evaluation

The remediation alternatives are evaluated against the short and long-term aspects of three broad categories: effectiveness, implementability and cost. The alternatives will be evaluated more generally in this phase in order to achieve the goal of narrowing the number of alternatives that will undergo detailed analysis (Tables 2 and 3).

5.2.5 Effectiveness Evaluation

Effectiveness evaluation of the alternative is performed to determine its effectiveness in protecting human health and the environment and its effectiveness in reducing toxicity, mobility and volume of the contaminant.

307228

5.2.6 Implementability Evaluation

Implementability evaluation is based on both technical and administrative feasibility of the specific technology. It is used to screen technologies and process options to eliminate those that are ineffective or unworkable at the site.

5.2.7 Cost Evaluation

The cost evaluation at this stage is intended to provide a relative comparison of process options within a technology type.

307229

TABLE 2

Evaluation of Remedial Technologies and Process Options for TCE and PCE Remediation

General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	Does not achieve remedial action objective	Easily implemented, May not be acceptable to local/federal authorities	None
Monitored Attenuation	None	Contaminant Monitoring	Does not achieve remedial action objective	Acceptability by local/federal authorities is to be determined. Easily implemented, Restrictions on future land use	Low capital, low maintenance
Institutional Controls	None	Deed Restriction	Does not achieve remedial action objective	Easily implemented, Restrictions on future land use	Low capital, Low maintenance
Containment	Cap	Asphalt	Effective but susceptible to weathering and cracking	Easily implemented, Restrictions on future land use	Low capital, high maintenance
Containment	Cap	Concrete	Effective but susceptible to weathering and cracking	Easily implemented, Restrictions on future land use	Moderate capital, high maintenance
Containment	Cap	Multi Media	Effective, least susceptible to weathering and cracking	Easily implemented, Restrictions on future land use	Moderate capital, Moderate maintenance
Removal	Excavation	Off-Site disposal	Effective	Difficult to implement due to location of contamination beneath the concrete floor inside Building 12. Easily implemented at Building 13	High Cost, disruption of facility operation, no maintenance
Removal	Excavation	On-Site Incineration	Very Effective for TCE and PCE .	Over kill due to the relatively low concentration of TCE and PCE	High Cost, disruption of facility operation, no maintenance
Removal	Excavation	On-Site Thermal Desorption	Very Effective for TCE and PCE.	Moderate Implementability	High Cost, disruption of facility operation, no maintenance
Removal	Excavation	On-Site Aeration	Effective for TCE and PCE.	Easily implemented	Low cost, disruption of facility operation, no maintenance
In-Situ Treatment	Soil Vapor Extraction	Vapor Extraction	Effective, slow process	Easily implemented	Moderate cost, moderate maintenance

307230

TABLE 2

Evaluation of Remedial Technologies and Process Options for TCE and PCE Remediation

General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
In-Situ Treatment	Thermal Extraction	Steam injection combined with vapor extraction	Effective, slow process	Moderate Implementability	Moderate cost, moderate maintenance
In-Situ Treatment	Thermal Extraction	Hot air injection combined with vapor extraction	Effective, slow process	Difficult to Implement	High Cost, moderate maintenance
In-situ-Treatment	Thermal Extraction	Electrical resistance heating with soil vapor extraction	Moderately effective, moderate process	Moderate Implementability	Moderate cost, moderate maintenance
In-situ-Treatment	Thermal Extraction	Radio-frequency heating with soil vapor extraction	Moderately effective, slow process	Moderate Implementability	Moderate cost, moderate maintenance
In-situ Bioremediation	Bioremediation	Aerobic or anaerobic microbial biodegradation	Moderately Effective, slow process	Moderate Implementability	Low cost
In situ Remediation	Phytoremediation	Grow poplar trees	Slow process	Easily implemented, Restrictions on future land use	Low capital, high maintenance
Chemical Treatment	In-situ Chemical Treatment	Ozone injection	Low effectiveness due to the impermeability of the soil	Difficult to implement	Moderate cost, high maintenance
Chemical Treatment	In-situ Chemical Treatment	Hydrogen peroxide injection	Low effectiveness due to the impermeability of the soil	Difficult to implement	Moderate cost high maintenance

307231

TABLE 3

Evaluation of Remedial Technologies and Process Options for Lead Remediation

General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	Does not achieve remedial action objective	Easily implemented, May not be acceptable to local/federal authorities	None
Institutional Controls	None	Deed Restriction	Does not achieve remedial action objective	Does not achieve remedial action objective	Low capital, low maintenance
Containment	Cap	Asphalt	Effective but susceptible to weathering and cracking	Easily implemented, Restrictions on future land use	Low capital, high maintenance
Containment	Cap	Concrete	Effective but susceptible to weathering and cracking	Easily implemented, Restrictions on future land use	Moderate capital, high maintenance
Containment	Cap	Multi Media	Effective, least susceptible to weathering and cracking	Easily implemented, Restrictions on future land use	Moderate capital, Moderate maintenance
Removal	Excavation	Ex-situ soil washing	Effective	Difficult to implement given the area required and restraints of the property	Moderate to high cost depending on quantity of soil to be treated
Removal	Excavation	Off Site disposal	Effective	Easily Implemented, The Lead contamination is confined to a relatively small area of the parking lot.	Low to Moderate cost
In situ Remediation	Phytoremediation	Grow poplar trees	Slow process	Easily implemented, Restrictions on future land use	Low capital, high maintenance

307232

5.3 Description of Seriously Considered Remedial Technologies

A preliminary evaluation of remedial technologies follows. The technologies evaluated include presumptive remedies. Where available, initial cost information is provided. Only the seriously considered remedial technologies are discussed in detail.

Soil vapor extraction (SVE), thermal desorption, and incineration are the presumptive remedies at Superfund sites with soils contaminated with halogenated volatile organic compounds (VOCs). Because a presumptive remedy is a technology that EPA believes, based upon its past experience, generally will be the most appropriate remedy for a specified type of site, the presumptive remedy approach will accelerate site-specific analysis of remedies by focusing the feasibility study efforts.

SVE is the EPA preferred presumptive remedy. SVE has been selected most frequently to address VOC contamination at Superfund sites, and performance data indicate that it effectively treats waste in place at a relatively low cost. In cases where SVE will not work or where uncertainty exists regarding the ability to obtain required cleanup levels, **thermal desorption** may be the most appropriate response technology. In a limited number of situations, **incineration** may be most appropriate.

The following technologies included in Tables 2 and 3 are not included in the descriptions presented below as they are not being seriously considered based on the site conditions and costs as identified in Tables 2 and 3:

- Excavation with On-site Incineration
- Excavation with On-site Thermal Desorption
- Excavation with On-site Soil Aeration
- Ex-situ Soil Washing

5.3.1 No Action

5.3.1.1 Description

Under the no action alternative, the remediation of the contaminated soils at the Klockner & Klockner property portion of Operable Unit #3 would end. There would be no reduction in the toxicity, and volume of contamination. Evaluation of the no action alternative is required under by EPA, as it provides a baseline against which impacts of other alternatives can be compared.

307233

5.3.1.2 Applicability

No Action alternative is applicable for TCE, PCE and Lead soil contamination.

5.3.1.3 Limitations

The no action alternative could expose humans and the environment to contaminated soil and ground water. Under this alternative, there would be no remediation, monitoring, or controls over the contaminated site. Although unlikely, exposure could occur in the following ways:

- Migration of the contamination to ground water
- Migration of contaminant to off-site location
- Vapor intrusion from contaminated soil and ground water

5.3.1.4 Data Needs

Data requirements include the area and depth of contamination, the concentration of the contaminants, depth to water table, and soil type and properties (e.g., structure, texture, permeability, and moisture content).

5.3.1.5 Performance Data

No action alternative is implemented in situations where the concentration of the contaminant is very low and the potential for migration is low.

5.3.1.6 Cost

This is the lowest cost alternative as no action is required for remediation.

5.3.2 Monitored Natural Attenuation

5.3.2.1 Description

Monitored natural attenuation (MNA) allows the toxicity of the contaminant to be reduced by a combination of various physical, chemical and biological processes taking place in the contaminated environment. These processes include biodegradation, volatilization and migration of the contaminant.

5.3.2.2 Applicability

MNA is applicable for TCE and PCE soil contamination. MNA is not applicable for Lead soil contamination.

307234

5.3.2.3 Limitations

MNA decreases the toxicity and volume of the TCE and PCE due to degradation, slow volatilization and migration. The volume of lead contamination is not reduced by MNA as it does not biodegrade or volatilize. Toxicity due to lead is not reduced due to relatively slow migration and dilution through the clayey silt. A restriction on future land use would be required until remediation goals are met.

5.3.2.4 Data Needs

Data requirements include the area and depth of contamination, the concentration of the contaminants, depth to water table, and soil type and properties (e.g., nutrients, structure, texture, permeability, and moisture content).

5.3.2.5 Performance Data

MNA is readily implemented and successfully used especially in combination with other Engineering and Institutional Controls.

5.3.2.6 Cost

MNA is a relatively low cost alternative, with monitoring of the contaminant being a major cost factor.

5.3.3 Institutional Control

5.3.3.1 Description

Institutional controls are designed to reduce exposure to toxic chemicals and protect human health by restricting land use. The most common institutional control is a restrictive covenant in the form of deed notice.

5.3.3.2 Applicability

Institutional Controls is applicable for TCE, PCE and Lead soil contamination.

5.3.3.3 Limitations

Institutional controls do not reduce the toxicity, mobility or the volume of the contaminant. A deed notice would specify any requirements for monitoring, maintenance of potential engineering controls and restrictions on property use to prevent the dispersion of or exposure to any contaminated soil. Restrictive covenants would also require notification of the presence of soil contamination and can be long term.

5.3.3.4 Data Needs

Data requirements include the area and depth of contamination, the concentration of the contaminants, depth to water table, and soil type and properties (e.g., structure, texture, permeability, and moisture content).

5.3.3.5 Performance Data

Institutional controls are readily available and have been successfully used.

5.3.3.6 Cost

The cost of imposing Institutional Controls is low to moderate as they involve long term monitoring and legal and administrative costs.

5.3.4 Capping/Containment

5.3.4.1 Description

Capping is a common form of remediation because it is generally less expensive than other technologies and effectively manages the human and ecological risks associated with a remediation site. The most common caps are Asphalt, Concrete and Multi Media.

The most effective single-layer caps are composed of concrete or bituminous asphalt. It is used to form a surface barrier between contaminated soil and the environment. An asphalt or concrete cap would reduce leaching through the soil into an adjacent aquifer.

5.3.4.2 Applicability

Caps may be applied to contaminated soil that is so large that other treatment is impractical. The cap can be used to minimize the infiltration of water through contaminated soil and the migration of contaminants into the ground water. In conjunction with water diversion and detention structures, caps may be designed to route surface water away from the contaminated soil. Capping is applicable for TCE, PCE and Lead soil contamination. As a majority of the contaminants are already under the foot print of the building, it is already capped. The remaining area outside the building can be easily capped to prevent migration of the contaminants.

307236

5.3.4.3 Limitations

Capping does not lessen toxicity, mobility, or volume of the contaminant, but does mitigate migration and exposure. Caps are most effective where most of the underlying contaminant is above the water table. A cap, by itself, cannot prevent the horizontal flow of ground water through the waste, only the vertical entry of water into the waste. Caps can be used in conjunction with vertical walls to minimize horizontal flow and migration. Caps are susceptible to weathering and cracking. Therefore, the effective life of a cap can be extended by long-term inspection and maintenance. Precautions must be taken to assume that the integrity of the cap is not compromised by land use activities. A restriction on future land use would be required.

5.3.4.4 Data Needs

Data requirements include the area and depth of contamination, the concentration of the contaminants, condition and type of existing cover (e.g. asphalt, concrete soil), depth to water table, and soil type and properties (e.g., structure, texture, permeability, and moisture content).

5.3.4.5 Performance Data

Previously installed caps are hard to monitor for performance. Monitoring well systems or infiltration monitoring systems can provide some information, but it is often not possible to determine the source of the contaminant. Caps are often installed to prevent, or significantly reduce, the migration of contaminants in soils or ground water. Containment is necessary whenever contaminated materials are to be buried or left in place at a site. In general, containment is performed when extensive subsurface contamination at a site precludes excavation and removal of wastes because of potential hazards, unrealistic cost, or lack of adequate treatment technologies.

5.3.4.6 Cost

Containment treatment such as caps offer quick installation times and are typically a low to moderate cost treatment group. Unlike ex situ treatment groups, containment does not require excavation of soils that lead to increased costs from engineering design of equipment, possible permitting, and material handling. However, capping requires periodic inspections. Additionally, ground water monitoring wells, associated with the treatments, may need to be periodically sampled and maintained. Even with these long-term requirements, containment treatments usually are considerably more economical than excavation and removal of the wastes.

307237

5.3.5 Excavation, Retrieval, and Off-Site Disposal

5.3.5.1 Description

Contaminated material is removed and transported to permitted off-site treatment and/or disposal facilities. Some pretreatment of the contaminated media usually is required in order to meet land disposal restrictions.

Confined disposal facilities (CDFs) are engineered structures enclosed by dikes and designed to retain disposed materials. A CDF may have a large cell for material disposal, and adjoining cells for retention and decantation of turbid, supernatant water. A variety of linings have been used to prevent seepage through the dike walls. The most effective are clay or bentonite-cement slurries, but sand, soil, and sediment linings have also been used.

Operation and maintenance duration lasts as long as the life of the facility.

5.3.5.2 Applicability

Excavation and off-site disposal is applicable to the complete range of contaminant groups with no particular target group. Therefore, it is applicable for TCE, PCE and Lead soil contamination. Excavation and off-site disposal by relocating the waste to a different (and presumably safer) site.

5.3.5.3 Limitations

Factors that may limit the applicability and effectiveness of the process include:

- Generation of fugitive emissions may be a problem during operations.
- The distance from the contaminated site to the nearest disposal facility with the required permit(s) will affect cost.
- Depth and composition of the media requiring excavation must be considered.
- Transportation of the soil through populated areas may affect community acceptability.
- Accessibility of the contaminated area to excavation under the site specific conditions.

5.3.5.4 Data Needs

Data requirements include the area and depth of contamination, the concentration of the contaminants, depth to water table, and soil type.

307238

5.3.5.5 Performance Data

Excavation and off-site disposal is a well proven and readily implementable technology. Prior to 1984, excavation and off-site disposal was the most common method for cleaning up hazardous waste sites. Excavation is the initial component in all ex situ treatments.

CERCLA includes a statutory preference for treatment of contaminants, and excavation and off-site disposal is now less acceptable than in the past. The disposal of hazardous wastes is governed by RCRA (40 CFR Parts 261-265), and the U.S. Department of Transportation (DOT) regulates the transport of hazardous materials (49 CFR Parts 172-179, 49 CFR Part 1387, and DOT-E 8876).

5.3.5.6 Cost

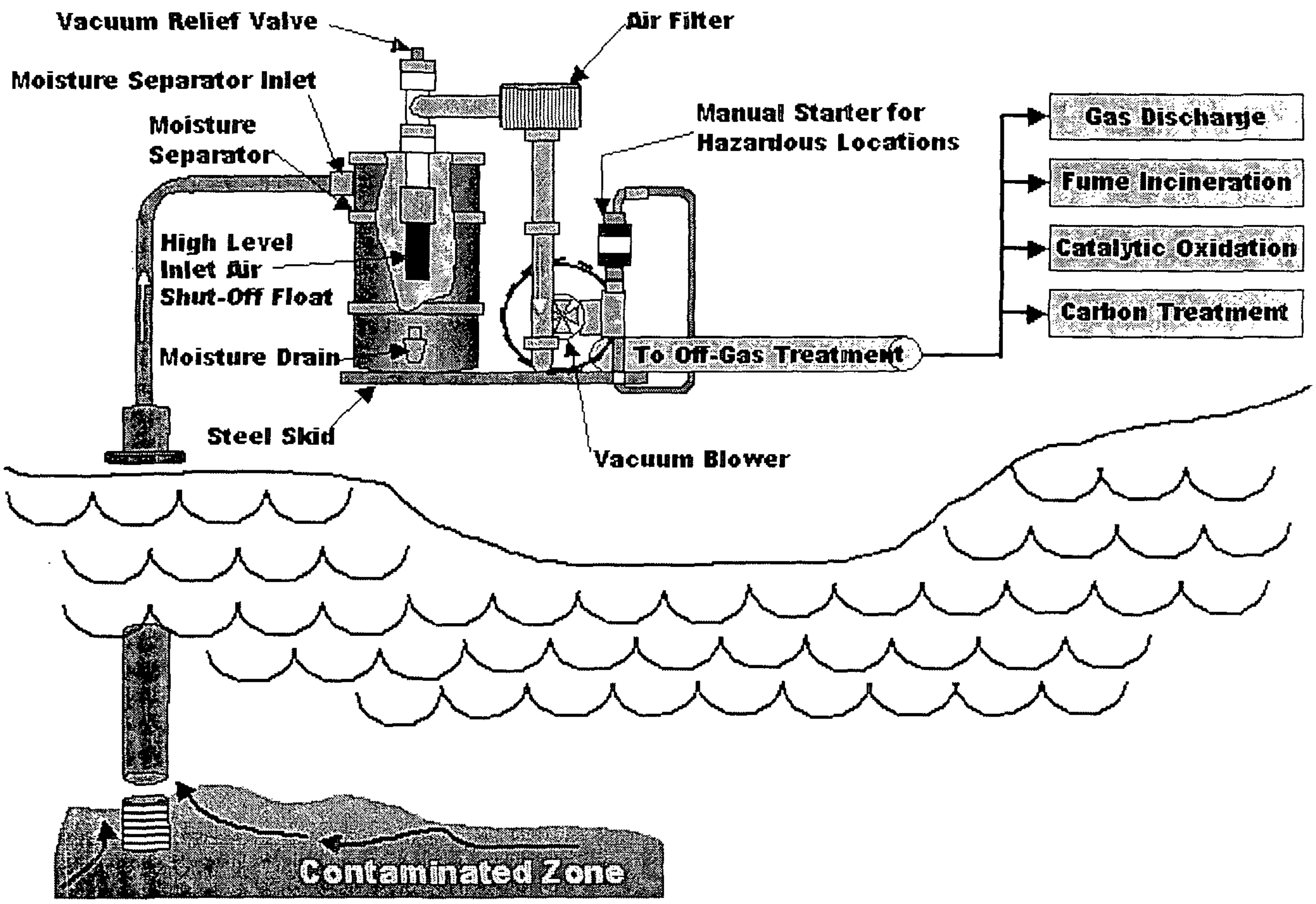
Cost estimates for excavation and disposal range from $300 to $510 per metric ton ($270 to $460 per ton). These estimates include excavation/removal, transportation, and disposal at a RCRA permitted facility. Additional cost of treatment at disposal facility may also be required. Excavation and off-site disposal is a relatively simple process, with proven procedures. It is a labor-intensive practice with little potential for further automation. Additional costs may include soil characterization and treatment to meet land ban requirements.

5.3.6 Soil Vapor Extraction

A vacuum is applied through extraction wells to create a pressure/concentration gradient that induces gas-phase volatiles to be removed from soil through extraction wells. This technology also is known as in situ soil venting, in situ volatilization, enhanced volatilization, or soil vacuum extraction.

307239

Typical In Situ Soil Vapor Extraction System



SVE is an in situ unsaturated (vadose) zone soil remediation technology in which a vacuum is applied to the soil to induce the controlled flow of air and remove volatile and some semivolatile contaminants from the soil. The gas leaving the soil may be treated to recover or destroy the contaminants, depending on local and state air discharge regulations. Vertical extraction vents are typically used at depths of 1.5 meters (5 feet) or greater. Horizontal extraction vents (installed in trenches or horizontal borings) can be used as warranted by contaminant zone geometry, drill rig access, or other site-specific factors.

Ground water depression pumps may be used to reduce ground water upwelling induced by the vacuum or to increase the depth of the vadose zone. Air injection is effective for facilitating extraction of deep contamination, contamination in low permeability soils, and contamination in the saturated zone. The duration of operation and maintenance for in situ SVE is typically 1 to 3 years.

307240

5.3.6.1 Applicability

The target contaminant groups for in situ SVE are VOCs and some fuels. The technology is typically applicable only to volatile compounds with a Henry's law constant greater than 0.01 or a vapor pressure greater than 0.5 mm Hg (0.02 inches Hg). Vapor Pressure for TCE is 58 mm of Hg, and for PCE it is 18.47 mm of Hg, making them good candidates for the process. SVE is not applicable to Lead. Other factors, such as the moisture content, organic content, and air permeability of the soil, also will impact the effectiveness of in situ SVE. Because the process involves the continuous flow of air through the soil, however, it often promotes the in situ biodegradation of low-volatility organic compounds that may be present.

5.3.6.2 Limitations

Factors that may limit the applicability and effectiveness of the process include:

- Soil that has a high percentage of fines and a high degree of saturation will require higher vacuums (increasing costs) and/or will hinder the operation of the in situ SVE system.
- Large screened intervals are required in extraction wells for soil with highly variable permeabilities or stratification, which otherwise may result in uneven delivery of gas flow from the contaminated regions.
- Soil that has high organic content or is extremely dry has a high sorption capacity of VOCs, which results in reduced removal rates.
- Exhaust air from in situ SVE system may require treatment to eliminate possible harm to the public and the environment.
- As a result of off-gas treatment, residual liquids may require treatment/disposal. Spent activated carbon definitely will require regeneration or disposal.
- SVE is not effective in the saturated zone.

5.3.6.3 Data Needs

Data requirements include the area and depth of contamination, the concentration of the contaminants, depth to water table, and soil type and properties (e.g., structure, texture, permeability, and moisture content).

Pilot studies should be performed to provide design information, including extraction well, radius of influence, gas flow rates, optimal applied vacuum, and contaminant mass removal rates.

307241

5.3.6.4 Performance Data

A field pilot study is necessary to establish the feasibility of the method as well as to obtain information necessary to design and configure the system. During full-scale operation, in situ SVE can be operated intermittently (pulsed operation) once the extracted mass removal rate has reached an asymptotic level. This pulsed operation can increase the cost-effectiveness of the system by facilitating extraction of higher concentrations of contaminants. After the contaminants are removed by in situ SVE, other remedial measures, such as biodegradation or engineering controls, can be investigated if remedial action objectives have not been met. In situ SVE projects are typically completed in 1 to 3 years.

5.3.6.5 Cost

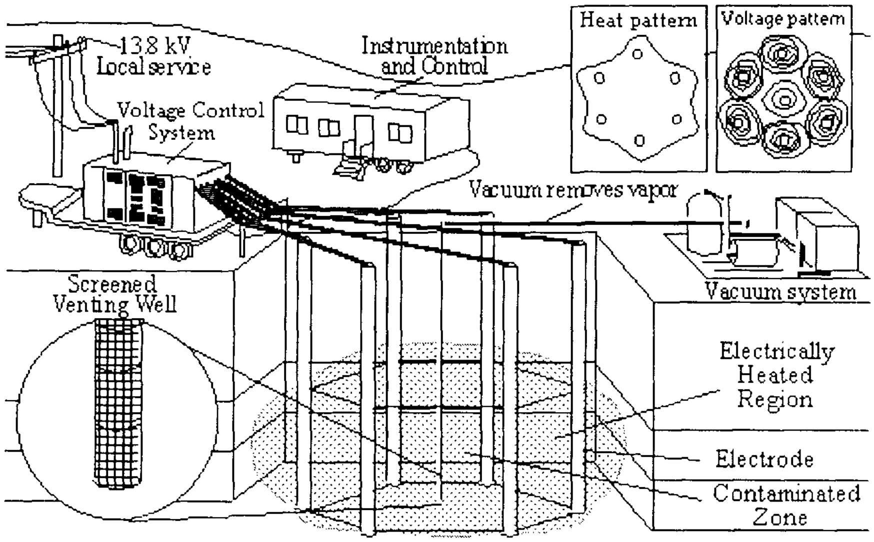
The cost of in situ SVE is site-specific, depending on the size of the site, the nature and amount of contamination, and the hydrogeological setting (EPA, July 1989). These factors affect the number of wells, the blower capacity and vacuum level required, and the length of time required to remediate the site. A requirement for off-gas treatment adds significantly to the cost. Water is also frequently extracted during the process and usually requires treatment prior to disposal, further adding to the cost. Cost estimates for in situ SVE range between $10 and $50 per cubic meter ($10 and $40 per cubic yard) of soil. Pilot testing typically costs $10,000 to $40,000.

5.3.7 In Situ Thermal Treatment

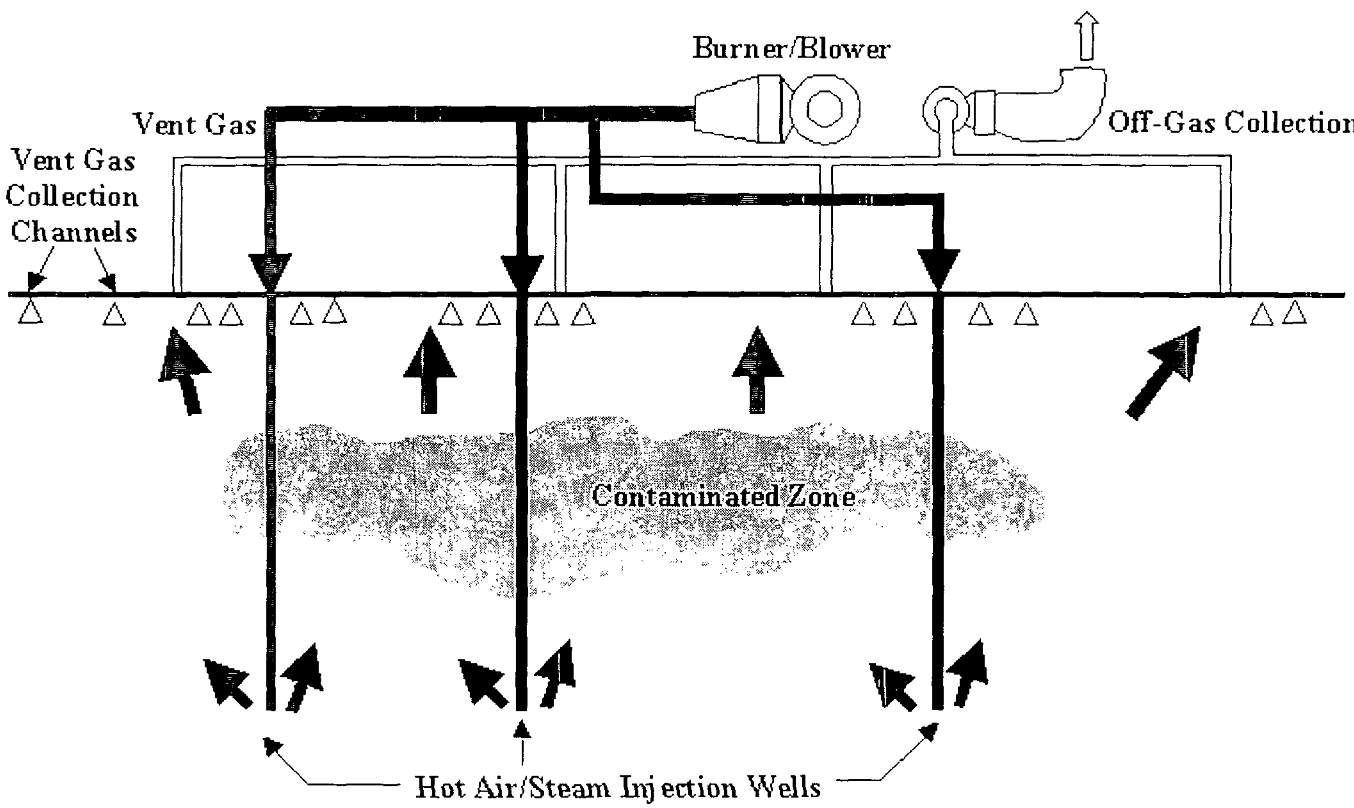
In situ thermal treatment is a full-scale technology that uses electrical resistance/electromagnetic/fiber optic/radio frequency heating or hot-air/steam injection to increase the volatilization rate of semi-volatiles and volatiles and facilitate extraction. The volatilized contaminants are collected by SVE. These technologies are discussed below.

307242

Typical Six-Phase Soil Heating System



Typical Hot Air System



307243

The process is otherwise similar to standard SVE, but requires heat resistant extraction wells. In situ thermal treatment with SVE is normally a short- to medium-term technology.

5.3.7.1 Electrical Resistance Heating

Electrical resistance heating uses an electrical current to heat less permeable soils such as clays and fine-grained sediments so that water and contaminants trapped in these relatively conductive regions are vaporized and ready for vacuum extraction. Electrodes are placed directly into the less permeable soil matrix and activated so that electrical current passes through the soil, creating a resistance, which then heats the soil. The heat dries out the soil causing it to fracture. These fractures make the soil more permeable allowing the use of SVE to remove the contaminants. The heat created by electrical resistance heating also forces trapped liquids to vaporize and move to the steam zone for removal by SVE. Six-phase soil heating (SPSH) is a typical electrical resistance heating which uses low-frequency electricity delivered to six electrodes in a circular array to heat soils. With SPSH, the temperature of the soil and contaminant is increased, thereby increasing the contaminant's vapor pressure and its removal rate. SPSH also creates an in situ source of steam to strip contaminants from soil. At this time SPSH is in the demonstration phase, and all large scale in situ projects utilize three-phase soil heating.

5.3.7.2 Radio Frequency/Electromagnetic Heating

Radio frequency heating (RFH) is an in situ process that uses electromagnetic energy to heat soil and enhance SVE. The RFH technique heats a discrete volume of soil using rows of vertical electrodes embedded in soil (or other media). Heated soil volumes are bounded by two rows of ground electrodes with energy applied to a third row midway between the ground rows. The three rows act as a buried triplate capacitor. When energy is applied to the electrode array, heating begins at the top center and proceeds vertically downward and laterally outward through the soil volume. The technique can heat soils to over 300 °C.

RFH enhances SVE in four ways: (1) contaminant vapor pressure and diffusivity are increased by heating, (2) the soil permeability is increased by drying, (3) an increase in the volatility of the contaminant from in situ steam stripping by the water vapor, and (4) a decrease in the viscosity which improves mobility. The technology is self limiting; as the soil heats and dries, current will stop flowing. Extracted vapor can then be treated by a variety of existing technologies, such as granular activated carbon or incineration.

307244

5.3.7.3 Hot Air/Steam Injection

Hot air or steam is injected below the contaminated zone to heat up contaminated soil. The heating enhances the release of contaminants from the soil matrix. Some VOCs and SVOCs are stripped from the contaminated zone and brought to the surface through SVE.

5.3.7.4 Applicability

High moisture content is a limitation of standard SVE that thermal enhancement may help overcome. Heating, especially radio frequency heating and electrical resistance heating can improve air flow in high moisture soils by evaporating water. The system is designed to treat semivolatiles but will consequently treat volatiles. In situ thermal treatment is not applicable to Lead. After application of this process, subsurface conditions are excellent for biodegradation of residual contaminants.

5.3.7.5 Limitations

The following factors may limit the applicability and effectiveness of the process:

- Debris or other large objects buried in the media can cause operating difficulties.
- Performance in extracting certain contaminants varies depending upon the maximum temperature achieved in the process selected.
- Soil that is tight or has high moisture content has a reduced permeability to air, hindering the operation of thermally enhanced SVE and requiring more energy input to increase vacuum and temperature.
- Soil with highly variable permeabilities may result in uneven delivery of gas flow to the contaminated regions.
- Soil that has a high organic content has a high sorption capacity of VOCs, which results in reduced removal rates.
- Air emissions may need to be regulated to eliminate possible harm to the public and the environment. Air treatment and permitting will increase project costs.
- Residual liquids and spent activated carbon may require further treatment.
- Thermally enhanced SVE is not effective in the saturated zone; however, lowering the aquifer can expose more media to SVE.
- Hot air injection has limitations due to low heat capacity of air.
- Difficulty in controlling the direction of the steam/hot air migration through the shallow silty clay.

307245

5.3.7.6 Data Needs

Data requirements include the area and depth of contamination, the concentration of the contaminants, depth to water table, and soil type and properties (e.g., structure, texture, permeability, and moisture content).

Pilot studies should be performed to provide design information, including extraction well, radius of influence, gas flow rates, optimal applied vacuum, optimal heat injection and contaminant mass removal rates.

5.3.7.7 Performance Data

Thermal Treatment has been used for the remediation of solvent contaminated soils. Its success will depend on the soil and sight conditions. A field pilot study is necessary to establish the feasibility of the method as well as to obtain information necessary to design and configure the system. After the contaminants are removed by in situ thermal treatment, other remedial measures, such as biodegradation or engineering controls, can be investigated if remedial action objectives have not been met.

5.3.7.8 Cost

Available data indicate the overall cost for thermally enhanced SVE systems is approximately $30 to $130 per cubic meter ($25 to $100 per cubic yard).

5.3.8 In-Situ Bioremediation

5.3.8.1 Description

During in-situ bioremediation, the activity of naturally occurring microbes is stimulated by circulating water-based solutions through contaminated soils to enhance in-situ biological remediation of organic contaminants. Nutrients, oxygen, or other amendments may be used to enhance bioremediation and contaminant desorption from subsurface materials. Generally, the process includes above-ground treatment and conditioning of the infiltration water with nutrients and an oxygen (or other electron acceptor) source. In-situ bioremediation is a full-scale technology.

5.3.8.2 Applicability

Target contaminants for in-situ bioremediation are non-halogenated VOCs and SVOCs, and fuel hydrocarbons. Halogenated VOCs and SVOCs also can be treated, but the process may

307246

be less effective and may only be applicable to some compounds within these contaminant groups. In-situ bioremediation is not applicable to Lead.

5.3.8.3 Limitations

The following factors may limit the applicability and effectiveness of this process:

- Extensive treatability studies and site characterization may be necessary.
- The circulation of water-based solutions through the soil may increase contaminant mobility.
- The injection of microorganisms into the subsurface is not recommended. Naturally occurring organisms are generally adapted to the contaminants present.
- Preferential flow paths may severely decrease contact between injected fluids and contaminants throughout the contaminated zones.
- The system should be used only where ground water is near the surface and where the ground water underlying the contaminated soils is contaminated.
- The system should not be used for clay, highly layered, or heterogeneous subsurface environments due to oxygen (or other electron acceptor) transfer limitations.
- Bioremediation may not be applicable at sites with high concentrations of heavy metals, highly chlorinated organics, or inorganic salts.

5.3.8.4 Data Needs

Data requirements include the area and depth of contamination, the concentration of the contaminants, type of microorganisms present and soil type and properties (e.g., nutrients, structure, texture, permeability, and moisture content).

Bench scale and/or pilot studies should be performed to provide design information, including nutrient requirements and contaminant mass removal rates.

5.3.8.5 Performance Data

Bioremediation has been successfully used for the treatment of Chlorinated solvent contaminated soil. The success of the process may be limited by the clay content of the soil, ability to create anaerobic conditions and ability to deliver nutrients to the contaminated areas.

5.3.8.6 Cost

In-situ Bioremediation is a moderate cost alternative.

307247

5.3.9 Phytoremediation

5.3.9.1 Description of Phytoremediation

Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil and sediment. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phyto-extraction (also called phyto-accumulation), phyto-degradation, and phyto-stabilization.

5.3.9.2 Enhanced Rhizosphere Biodegradation

Enhanced rhizosphere biodegradation takes place in the soil immediately surrounding plant roots. Natural substances released by plant roots supply nutrients to microorganisms, which enhances their biological activities. Plant roots also loosen the soil and then die, leaving paths for transport of water and aeration. This process tends to pull water to the surface zone and dry the lower saturated zones.

The most commonly used flora in phytoremediation projects are poplar trees, primarily because the trees are fast growing and can survive in a broad range of climates. In addition, poplar trees can draw large amounts of water (relative to other plant species) as it passes through soil or directly from an aquifer. This may draw greater amounts of dissolved pollutants from contaminated media and reduce the amount of water that may pass through soil or an aquifer, thereby reducing the amount of contaminant flushed through or out of the soil or aquifer.

5.3.9.3 Phyto-accumulation

Phyto-accumulation is the uptake of contaminants by plant roots and the translocation/accumulation (phytoextraction) of contaminants into plant shoots and leaves.

5.3.9.4 Phyto-degradation

Phyto-degradation is the metabolism of contaminants within plant tissues. Plants produce enzymes, such as dehalogenase and oxygenase that help catalyze degradation. Investigations are proceeding to determine if both aromatic and chlorinated aliphatic compounds are amenable to phyto-degradation.

5.3.9.5 Phyto-stabilization

Phyto-stabilization is the phenomenon of production of chemical compounds by plants to immobilize contaminants at the interface of roots and soil.

307248

5.3.9.6 Applicability

Phytoremediation is applicable for the remediation of metals such as Lead and solvents including TCE and PCE.

Some plant species have the ability to store metals in their roots. They can be transplanted to sites to filter metals from wastewater. As the roots become saturated with metal contaminants, they can be harvested.

Hyper-accumulator plants may be able to remove and store significant amounts of metallic contaminants.

Currently, trees are under investigation to determine their ability to remove organic contaminants from ground water, translocate and transpiration, and possibly metabolize them either to CO_2 or plant tissue.

5.3.9.7 Limitations

Limitations to phytoremediation in soil at the subject site include:

- The depth of the treatment zone is determined by plants used in phytoremediation. In most cases, it is limited to shallow soils.
- High concentrations of hazardous materials can be toxic to plants.
- It involves the same mass transfer limitations as other biotreatments.
- It may be seasonal, depending on location.
- Access. A majority of the contamination area is under the footprint of the building, under 12" of concrete slab.
- It can transfer contamination across media, e.g., from soil to air.
- It is not effective for strongly sorbed (e.g., PCBs) and weakly sorbed contaminants.
- The toxicity and bioavailability of biodegradation products is not always known.
- It is still in the demonstration stage.
- It is unfamiliar to regulators.

307249

5.3.9.8 Data Needs

Detailed information is needed to determine the kinds of soil used for phytoremediation projects. Water movement, reductive oxygen concentrations, root growth, and root structure all affect the growth of plants and should be considered when implementing phytoremediation.

5.3.9.9 Cost

Available data indicate the overall cost for phytoremediation is moderate.

5.3.10 In-situ Chemical Oxidation

5.3.10.1 Description

Highly effective ozone generating systems have been designed to destroy the contaminants PCE and TCE in situ. It has long been known that ozone is an extremely effective chemical oxidizer and much data has been published indicating the effectiveness of ozone for treating PCE, TCE, vinyl chloride, DCE, and other chlorinated solvents. Several projects conducted in the State of Florida at dry cleaning facilities have demonstrated the potential for ozone to clean up PCE and TCE contaminated sites.

5.3.10.2 Applicability

The target contaminant group for oxidation/reduction is inorganics. The technology can be used as well to treat halogenated VOCs, but may be less effective for those contaminants. Oxidation/reduction is a well-established technology used for disinfecting drinking water and wastewater, and is a common treatment for cyanide wastes. Enhanced systems are now being used more frequently to treat hazardous wastes in soils.

In situ chemical oxidation using ozone generation system offers a number of significant advantages for on-site remediation, including:

- Potential for complete destruction of PCE and TCE without the formation of harmful byproducts
- Low operating costs
- PCE, TCE and other chlorinated solvents are treated in one system

In situ oxidation is not applicable to Lead as it is an element.

307250

5.3.10.3 Limitations

The following factors may limit the applicability and effectiveness of this process:

- Potential for incomplete oxidation or formation of intermediate contaminants that are more toxic than the original contaminants may occur depending upon the contaminants and oxidizing agents used. (The CVOCs of concern are readily oxidized with any potential intermediates being short lived and readily oxidized themselves.)
- The process is not cost-effective for highly contaminated materials due to the large amounts of oxidizing/reducing agents required.
- The chemicals used in oxidation/reduction pose a potential health and safety risk to site workers through skin contact and air emissions. Personal protective equipment, at a level commensurate with the contaminants involved, is normally required during treatment operations.

5.3.10.4 Data Needs

Engineering of in situ chemical oxidation must be done with due attention paid to reaction chemistry and transport processes. It is also critical that close attention be paid to worker training and safe handling of process chemicals as well as proper management of remediation wastes. The design and implementation process should rely on an integrated effort involving screening level characterization tests and reaction transport modeling, combined with treatability studies at the lab and field scale.

5.3.10.5 Performance Data

In situ chemical oxidation is a viable remediation technology for mass reduction in source areas as well as for plume treatment. The potential benefits of in situ oxidation include the rapid and extensive reactions with various COCs applicable to many bio-recalcitrant organics and subsurface environments. Also, in situ chemical oxidation can be tailored to a site and implemented with relatively simple, readily available equipment. Some potential limitations exist including the requirement for handling large quantities of hazardous oxidizing chemicals due to the oxidant demand of the target organic chemicals and the unproductive oxidant consumption of the formation; some COCs are resistant to oxidation; and there is a potential for process-induced detrimental effects. Further research and development is ongoing to advance the science and engineering of in situ chemical oxidation and to increase its overall cost effectiveness

5.3.10.6 Cost

307251

This is a high cost process option.

6.0 INITIAL SCREENING OF PROCESS OPTIONS

The purpose of this section is to review the initial list of process options and screen that list to eliminate those options that are not appropriate to Operable Unit #3 in accordance with the screening criteria identified in the EPA guidance document Feasibility Study rule. Under the Feasibility Study rule, process options must be evaluated in terms of their effectiveness, cost, timeliness, and whether they are considered acceptable engineering practices given the option's feasibility for the location and reliability.

Whitman applied these regulatory criteria to the site-specific information such as geologic or hydrogeologic conditions and contaminant type and concentration. Published and personal accounts of technology performance and professional judgment also were included in the evaluation process. Reasons for eliminating remedial technologies and process options are presented in the following section and summarized in Table 4 for TCE and PCE and Table 5 for Lead. Surviving options receive a more detailed review in section 7.0 of this document.

6.1 Eliminated Process Options

Several process options were eliminated prior to forming the preliminary remedial alternatives. The basis for elimination of each is described in Section 5.3 and Tables 4 and 5 below. These process options are denoted with "no" in the final column of Tables 4 and 5.

307252

TABLE 4

Screening and Elimination of Process Options for TCE and PCE for Klockner Property

Process Options	Protection of human health and the environment	Compliance with ARARs	Long term effectiveness	Reduce the toxicity, mobility, and volume of the contamination	Short term effectiveness	Implementability	Cost Effectiveness	State acceptance	Community acceptance	Preliminary remedial alternative
No Action	No	No	No	No	No	Implementable	Yes	Not acceptable	Not Acceptable	Yes
Institutional Control	None to low	No	No	No	No	Implementable	Yes	Not acceptable	Not Acceptable	Yes
Monitored Natural Attenuation	Moderate	Yes	Yes	No	Moderate	Implementable	Yes	Acceptable	Acceptable	Yes
Capping with Asphalt	Moderate to high	Partial compliance	Moderate to high	Slow reduction	Yes	Implementable	Cost effective	Acceptable	Acceptable	Yes
Capping with Concrete	Moderate to high	Partial compliance	Moderate to high	Slow reduction	Yes	Implementable	Cost effective	Acceptable	Acceptable	Yes
Capping with multi media	Moderate	Partial compliance	Moderate	Slow reduction	Yes	Not implementable. Affects the indended use due to altering the elevation of the area	Cost effective	Acceptable	Acceptable	No
Partial Excavation	Moderate to high	Yes	Moderate to high effectiveness	Moderate to high reduction	Moderate to high effectiveness	Implementable	Cost effective	Acceptable	Acceptable	Yes
Excavation with Off-site disposal	High	Yes	High Effectiveness	High Reduction	Very Effective	Disruption of established business operation	High cost	Acceptable	Acceptable	No
Excavation with On-site incineration	Moderate to high	Yes	Moderate to high effectiveness	High reduction	Moderate to high effectiveness	Not implementable due to disruption of established business	High cost	Acceptable	Not Acceptable	No
Excavation with On-site thermal desorption	Moderate to high	Yes	Moderate to high effectiveness	High reduction	Moderate to high effectiveness	Not implementable due disruption of established business operation	High cost	Acceptable	Not Acceptable	No

307253

TABLE 4

Screening and Elimination of Process Options for TCE and PCE for Klockner Property

Process Options	Protection of human health and the environment	Compliance with ARARs	Long term effectiveness	Reduce the toxicity, mobility, and volume of the contamination	Short term effectiveness	Implementability	Cost Effectiveness	State acceptance	Community acceptance	Preliminary remedial alternative
Excavation with On-site soil aeration	Moderate to high	Yes	Moderate to high effectiveness	Moderate to high reduction	Moderate to high effectiveness	Not implementable due to disruption of established business operation	Low cost	Acceptable	Not Acceptable	No
SVE	Moderate to high	Yes	Moderate to high effectiveness	Moderate to high reduction	Effective	Implementable	Low to Moderate cost	Acceptable	Acceptable	Yes
Steam injection with SVE	Moderate to high	Yes	Moderate to high effectiveness	Moderate to high reduction	Not Effective due to difficulty in directing steam through silty clay	Implementable	Moderate to high cost	Acceptable	Acceptable	No
Hot air injection SVE	Moderate to high	Yes	Moderate to high effectiveness	Moderate to high reduction	Not Effective due to difficulty in directing hot air through silty clay	Implementable	Moderate to high cost	Acceptable	Acceptable	No
Radio frequency heating with SVE	Moderate to high	Yes	Moderate effectiveness	Moderate to high reduction	Moderately effective	Implementable	High cost	Acceptable	Acceptable	No
Electrical Resistance Heating with SVE	Moderate to high	Yes	Moderate effectiveness	Moderate to high reduction	Moderately effective	Implementable	High cost	Acceptable	Acceptable	No
In-situ Chemical treatment with Ozone	Moderate to high	Yes	High Cost	Moderate to high reduction	Low effectiveness	Low Implementability	High cost	Acceptable	Acceptable	No
In-situ Chemical treatment with Hydrogen peroxide	Moderate to high	Yes	High Cost	Moderate to high reduction	Low effectiveness	Low Implementability	High cost	Acceptable	Acceptable	No
Bioremediation	Low to moderate	Yes	Low to moderate cost	Low to moderate reduction	Low to moderate effectiveness	Implementable	Low to moderate cost	Acceptable	Acceptable	No
Phytoremediation	Low to moderate	Yes	Low to moderate cost	Low to moderate reduction	Low to moderate effectiveness	Implementable	Low to moderate cost	Acceptable	Acceptable	No

307254

TABLE 5

Screening And Elimination Of Process Options For Lead for Klockner Property

Process options	Protection of human health and the environment	Compliance with ARARs	Long term effectiveness	Reduce the toxicity, mobility, and volume of the contamination	Short term effectiveness	Implementability	Cost Effectiveness	State acceptance	Community acceptance	Preliminary remedial alternative
No Action	No	No	No	No	No	Implementable	Yes	Not acceptable	Not Acceptable	Yes
Institutional Control	None to low	Partial compliance	No	No	No	Implementable	Yes	Not acceptable	Not Acceptable	Yes
Capping with Asphalt	Moderate to high	Partial compliance	Moderate to high	Reduction in mobility only	Yes	Implementable	Yes	Acceptable	Acceptable	Yes
Capping with Concrete	Moderate to high	Partial compliance	Moderate to high	Reduction in mobility only	Yes	Implementable	Yes	Acceptable	Acceptable	No
Capping with multi media	Moderate	Partial compliance	Moderate	Reduction in mobility only	Yes	Not implementable. Affects the indended use due to altering the elevation of the area	Yes	Acceptable	Acceptable	No
Phytoremediation	Low to moderate	Yes	Yes	Slow reduction	No	Not implementable. Affects the indended use due to altering the elevation of the area	No	Acceptable	Acceptable	No
Ex-situ Soil Washing	Moderate to high	Yes	Yes	Yes	Yes	Not implementable	No	Acceptable	Acceptable	No
Excavation and offsite disposal	High	Yes	Yes	Yes	Yes	Implementable	Yes	Acceptable	Acceptable	Yes

307255

7.0 DETAILED ANALYSIS OF ALTERNATIVES

7.1 Description of Remedial Alternatives

Using the surviving process options, Whitman has developed an array of remedial alternatives that can eliminate, reduce, or control the potential risks to human health and the environment present at the Klockner Property. The remedial alternatives are combinations of the surviving process options.

The following key site-specific conditions also were considered during development of the Unit #3 alternatives:

- the distribution of TCE, PCE and Lead
- existing remedial actions
- a major transportation corridor
- the commercial and residential nature of the surface above the majority of the Klockner Property

Several remedial alternatives were developed from the above surviving process options.

They differ primarily in the treatment location and the mode of treated waste disposal. The alternatives are described below.

7.1.1 Description of Remedial Alternatives for TCE and PCE

The process options that survived the initial screening and are used to form the remedial alternatives described below for the TCE and PCE soil contamination include:

- No action
- Monitored Natural Attenuation (MNA)
- Institutional Control
- Capping (Engineering Control)
- Excavation
- Soil Vapor Extraction (SVE)

7.1.1.1 Alternative 1: No Action

The No Action Alternative (Alternative 1) would not actively control, treat, or monitor the contamination in soil. The TCE and PCE would be allowed to migrate, dissipate, and decay naturally.

307256

Cost: There would be no capital or operating, maintenance, or monitoring cost for this alternative. It would be the least expensive alternative.

Time: Concentrations of TCE and PCE would remain above clean-up goals until natural attenuation processes degrade or disperse the contaminant mass. Literature reports both aerobic and anaerobic biodegradation of TCE and PCE in nature. Evaporation, dispersion, adsorption and biodegradation will continue to reduce TCE and PCE concentrations in the soil. The period of time required to achieve the applicable cleanup standard with no action would depend upon the rate of migration through the clayey silt and the observed rate of attenuation. Additional investigation to obtain this data is necessary to determine when the applicable cleanup standard will be achieved under this alternative. It is anticipated that the cleanup horizon for this alternative would be longer than under the active remediation alternatives.

7.1.1.2 Alternative 2: Monitored Natural Attenuation, Institutional and Engineering Controls

Alternative 2 is a combination of MNA, Institutional Controls and Engineering Controls. Each of the process options are described below.

7.1.1.2.1 Monitored Natural Attenuation

USEPA (1999b) also has reiterated the viability of MNA as an alternative means of achieving remediation objectives that may be appropriate for specific, well-documented site conditions. Per a recent policy statement, USEPA (1999b) expects that sole reliance on MNA as the remediation approach will be appropriate only for sites that have a low potential for contaminant migration. The Klockner Property is a candidate for MNA considering the site conditions in combination with other process options such as capping. The larger portion of the contaminated soil resides under a concrete slab, which prevents migration through water percolation. The soil is mostly clayey silt with low permeability and, therefore, has a low potential for contaminant migration. The rest of the area is capped with asphalt with the exception of a small area at Building 13.

The natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act (without human intervention) to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or ground water. This process will be applicable for TCE and PCE soil contamination at the site. These in situ processes can include biodegradation, dispersion, dilution, sorption, volatilization, decay, and chemical or biological stabilization, transformation, or destruction of contaminants. In conjunction with capping, vertical migration of the contaminants to the ground water will be prevented.

307257

This alternative may include monitoring of soil and ground water conditions and contaminant movement while controlling potential exposure risks through either restrictive covenants or a local ordinance. Changes in contaminant levels in the ground water would be monitored by periodic sampling of ground water from monitoring wells. Samples would be analyzed for TCE, PCE, and selected MNA parameters.

The components of this alternative include potential long-term monitoring, capping to prevent vertical migration to the ground water and use of institutional controls to control exposure.

Long-term monitoring of TCE, PCE and other MNA parameters may be necessary to document plume changes with time and distance.

7.1.1.2.2 Institutional Controls

Exposure control methods using institutional controls are potentially applicable to the site. The most common institutional Control is Restrictive Covenants. Under this scenario, restrictive covenants in the form of a deed notice notifying of the presence of soil contamination, requirements for maintaining any engineering controls and any restrictions on property use and disturbing contaminated soils would be imposed. A deed notice would identify requirements for monitoring to ensure that the conditions described therein are met to prevent potential exposure risks.

7.1.1.2.3 Engineering Controls

Engineering controls in the form of capping/containment are applicable to the site. The cap prevents migration of the contaminant and prevents it from acting as a source. The primary route of contaminant migration from the soil to the ground water is typically through the movement of water through the soil column. If water is prevented from percolating through the contaminated soil, further migration could be prevented or limited. The presence of asphalt paved surfaces and concrete floored building coverage at the site will prevent the infiltration of water through the contaminated soil although some infiltration may occur (i.e. through damaged pavement and through the unpaved former tank excavation area in the alleyway). The Remedial Investigation studies show that the contamination at the site is limited to a depth of <5 to 7 feet. The contaminants remaining above the identified cleanup concentrations are mostly present in clayey silt, restricting further migration of the contaminants. Ground water levels fluctuate which is a potential contaminant migration pathway if a rise in the water table contacts remaining contaminants. This is not likely to occur in the areas targeted for remediation as the shallowest depth to ground water historically measured in the monitoring wells at the Klockner Property (see Attachment 1) has not been less than approximately 11 feet below grade while the soil contamination is present at depths <5 to 7 feet below grade.

Cost: There would be a limited amount of capital or operating and maintenance cost for this alternative. Monitoring costs would continue for an extended period of time. Although the frequency of any necessary sampling would decrease over time, total monitoring costs could be substantial. Also, legal costs may comprise an important component of this alternative due to the need to negotiate restrictive covenants or develop an appropriate ordinance. Enforcement (maintenance) of the restrictive covenants and/or the city ordinances would be triggered when a property is sold or when construction permits or utility services are sought.

Time: Concentrations of TCE and PCE would remain above clean-up goals until naturally attenuated. The period of time required to achieve the applicable cleanup standard for TCE and PCE would depend upon various factors that affect rate of attenuation. Additional evaluation is necessary to determine when the applicable cleanup standard will be achieved under this alternative. It is anticipated that the cleanup horizon for this alternative would be somewhat longer than under the MNA and somewhat longer than active remediation alternatives.

7.1.1.3 Alternative 3: Excavation – Off-site Treatment

This alternative involves the excavation of the affected soil followed by off-site disposal.

Excavation: Operable Unit #3 consists of Building 12 and Building 13 Properties. Both buildings house businesses. Excavation of affected soil would involve complete disruption of the Building 12 business operation. Building 12 is constructed on a concrete slab. The excavation would involve excavating through concrete and removing soil to a depth of 5 to 7 feet. This process would cause significant noise and dust pollution in the mostly residential and light commercial neighborhood. Complete soil excavation would result in disruption of the established use of the site. This alternative is eliminated from further consideration. However a partial excavation and off-site disposal of the soil out side the foot print of the building is a practical alternative as it addresses the entire lead contaminated area and part of the TCE and PCE contaminated area.

Cost: There would be a significant amount of capital or operating cost required for this alternative. Monitoring costs would be eliminated for the contaminants. This is a high cost alternative as it involves excavation of large quantities soil in side as well as out side the building. The offsite disposal of large quantities of contaminated soil is high.

Time: Concentrations of TCE and PCE would be immediately reduced below clean-up goals. The period of time required to achieve the applicable cleanup standard for TCE and PCE would depend mainly on the excavation of contaminated soil and off-site disposal. It is anticipated that the cleanup horizon for this alternative would be shorter than under all other remediation alternatives.

7.1.1.4 Alternative 4: Partial Excavation and Off-Site Disposal

The TCE and PCE contaminated areas include the unpaved area at the Building 13 Property, the asphalt paved areas outside Building 12 as well as soil under the foot print of Building 12. The unpaved and asphalt paved areas are accessible for excavation with minimal disruption of the business operations at the site. A combination of partial excavation combined with off-site disposal of the contaminated soil is implementable, cost effective and addresses the partial removal of TCE and PCE contamination out the foot print of the building at the site.

Cost: There would be a limited amount of capital or operating and maintenance cost for this alternative. Monitoring costs would be eliminated for TCE and PCE in the excavated area only. There would be additional costs associated with the remediation of TCE and PCE located below the building foot print

Time: Concentrations of TCE and PCE would be immediately reduced below clean-up goals in the excavated area. Concentration of TCE and PCE would remain above cleanup levels under the foot print of the building. The period of time required to achieve the applicable cleanup standard for TCE and PCE would depend upon additional remedial alternates used in combination with Partial Excavation and Off-Site disposal. It is anticipated that the cleanup horizon for this alternative would be somewhat shorter than under the MNA and somewhat longer than active remediation alternatives.

7.1.1.5 Alternative 5: Soil Vapor Extraction

SVE can be instituted with the least disruption of the established use of the Klockner Property. SVE is a cost effective process option that would achieve the remediation objective. SVE is a presumptive technology that is proven to be effective for solvents such as TCE and PCE. Lead, however, is a non-volatile heavy metal that cannot be remediated with SVE technology.

The Lead and PCE contaminated areas are a subset of the TCE contaminated area. The Lead contamination is confined to the asphalt paved area adjacent to the Quonset Hut outside Building 12, along the fence. Excavation of 27 cubic yards of soil will remove the Lead contamination. This soil would be disposed of at a permitted landfill and the area would be back filled with clean fill material. This process will remove some of the contamination; the residual contamination bound up in the less permeable soil (silty clay) will be addressed with a combination of capping and institutional control.

Cost: There would be a limited amount of capital or operating and maintenance cost for this alternative. Monitoring costs would continue for a limited period of time.

Time: Concentrations of TCE and PCE would decrease significantly in the initial phase of the operation under this alternative. The residual concentration of the TCE and PCE would remain above clean-up goals until natural attenuation occurs. The period of time required to achieve the applicable cleanup standard would depend upon various factors. Additional evaluation and pilot study is necessary to determine when the applicable cleanup standard will be achieved under this alternative. It is anticipated that the cleanup horizon for this alternative would be significantly shorter than under the No Further Action and the MNA and Institutional Controls remediation alternatives.

7.1.2 Description of Remedial Alternatives for Lead

The process options that survived the initial screening and are used to form the remedial alternatives described below for the Lead soil contamination include:

- No action
- Institutional Control
- Capping (Engineering Control)
- Excavation

7.1.2.1 No Action

The No Action alternative would not actively control, treat, or monitor the contamination in soil. Lead in soil would migrate and dissipate.

Cost: There would be no capital or operating, maintenance, or monitoring cost for this alternative. It would be the least expensive alternative.

Time: Concentrations of Lead would remain above clean-up goals until migration or dispersion of the contaminant mass. The period of time required to achieve the applicable cleanup standard with no action would depend upon the rate of migration through the clayey silt. Additional investigation to obtain this data is necessary to determine when the applicable cleanup standard will be achieved under this alternative. It is anticipated that the cleanup horizon for this alternative would be longer than under the active remediation alternatives. The

307261

concentration of Lead would remain above clean-up goals, as it does not degrade. Migration and dilution of Lead, if any, will be limited due to the clayey silt.

7.1.2.2 Institutional and Engineering Controls

This alternative is a combination of Institutional and Engineering Controls. Each of the process options are described below. MNA which is included for the complementary alternative described above for TCE and PCE, is not included for Lead as it is not applicable to the Lead soil contamination.

7.1.2.2.1 Institutional Control

Exposure control methods using institutional controls are potentially applicable to the site

Restrictive Covenants: Under this scenario, restrictive covenants in the form of a deed notice notifying of the presence of soil contamination, requirements for maintaining any engineering controls and any restrictions on property use and disturbing contaminated soils would be imposed. A deed notice would identify requirements for monitoring to ensure that the conditions described therein are met to prevent potential exposure risks.

7.1.2.2.2 Engineering Control

Engineering controls in the form of capping/containment are applicable to the site. The cap prevents migration of Lead and prevents it from acting as a source. The primary route of contaminant migration from the soil to the ground water is typically through the movement of water through the soil column. If water is prevented from percolating through the contaminated soil, further migration could be prevented or limited. The Lead contaminated area is confined to an asphalt paved area outside the Quanset Hut. The presence of paved surfaces coverage at the site will prevent the infiltration of water through the contaminated soil although some infiltration may occur (i.e. through damaged pavement). The Lead contamination remaining above the identified cleanup concentrations are mostly present in clayey silt, restricting further migration. Ground water levels fluctuate which is a potential contaminant migration pathway if a rise in the water table contacts remaining contaminants. This is not likely to occur in the areas targeted for remediation as the shallowest depth to ground water historically measured in the monitoring wells at the Klockner Property (see Attachment 1) has not been less than approximately 11 feet below grade while the soil contamination is present at a depth of less than 2 feet below grade.

Cost: There would be a limited amount of capital or operating and maintenance cost for this alternative. Monitoring costs would continue for an extended period of time. Although the frequency of any necessary sampling would decrease over time, legal costs may comprise an important component of this alternative due to the need to negotiate restrictive covenants or develop an appropriate ordinance. Enforcement (maintenance) of the restrictive covenants and/or the city ordinances would be triggered when a property is sold or when construction permits or utility services are sought.

Time: Concentrations of Lead would remain above clean-up goals. It is anticipated that the cleanup horizon for this alternative would be longer than under the other active remediation alternatives.

7.1.2.3 Excavation and Off-site Disposal

The Lead contamination is localized in an area outside the building foot print adjacent to the Quonset Hut. The subject area is paved with asphalt, therefore more accessible for excavation with minimal disruption to the business operation at the site. A combination of excavation combined with off-site disposal of the Lead contaminated soil is implementable, cost effective and completely addresses the Lead contamination at the site.

Cost: There would be a limited amount of capital or operating cost and no maintenance cost associated with this alternative. Monitoring costs for Lead would be eliminated upon excavation and disposal of the contaminated soil.

Time: Concentrations of Lead would decrease to below clean up goals immediately. The period of time required to achieve the applicable cleanup standard would be short. The cleanup horizon for this alternative would be significantly shorter than under the No Further Action and the Institutional and Engineering Controls remedial alternatives.

8.0 CONCLUSION

This First Amended Technical Memorandum for Development and Screening of Alternatives for Site Remediation has systematically evaluated all identified alternatives to arrive at the remedial alternatives for a comprehensive response to the Operable Unit #3 soil contamination. Five remedial alternatives including No Action, MNA with Institutional and Engineering Controls, Excavation, Partial Excavation and SVE survived initial screening and were evaluated further. Two of the five alternatives were eliminated from further consideration for the reasons described in the following paragraph. The three surviving remedial alternatives are discussed below. Each alternative was evaluated with respect to the evaluation criteria listed in Section 3.0. Whitman has weighed the advantages and disadvantages of the remedial alternatives detailed in Section 5 and 6 to arrive at the preferred remedial alternatives.

307263

Most of the remedial alternatives are very expensive. The least expensive alternative is No Action alternative. Whitman has not selected this alternative because there is insufficient indication that the alternative would be approved by EPA or NJDEP. Alternative 2, Monitored Attenuation with Institutional Controls and Engineering Controls is the next least expensive alternative. This alternative may be adopted with approval by the regulatory agencies and the public support necessary to implement institutional controls. Whitman does not believe it is appropriate to recommend Alternative 2 at this time, although if regulatory agency and public support develops for this alternative, it may become viable at a later time. Alternative 3 is excavation followed by off site disposal which is ruled out as it is expensive and results in complete disruption of the current use of the property. Alternative 4 is partial excavation followed by off- site disposal. This is a viable option as it completely addresses the removal of Lead contaminated soil and part of the TCE and PCE soil and it does not disrupt the current use of the property. This alternative is less expensive than Alternative 3.

With respect to the remaining alternatives, Alternative 5, SVE, is the third least costly alternative. This alternative could be combined with excavation to address the Lead contamination.

Based on the above evaluation, the most viable options for the Klockner Property would be combinations of the following alternatives:

1. Excavation of the Lead contaminated soil followed by off-site disposal along with engineering and institutional controls for TCE and PCE soil contamination.

   Or

2. Excavation of the Lead contaminated soil followed by off site disposal, limited SVE of the TCE and PCE soil contamination exterior of the building foot print, and engineering and institutional controls for soil under the building foot print.

   Or

3. Excavation of the Lead contaminated soil followed by off site disposal and SVE of the TCE and PCE contaminated soil areas (under the building foot print and exterior of the building foot print).

307264

9.0 REFERENCES

Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA Interim Final EPA/540/G-89/004 OSWER Directive 9355.3-01 October 1988

User Guide to the VOCs in Soils. Presumptive Remedy (EPA, 1996).EPA Document No. 540-F-96-008

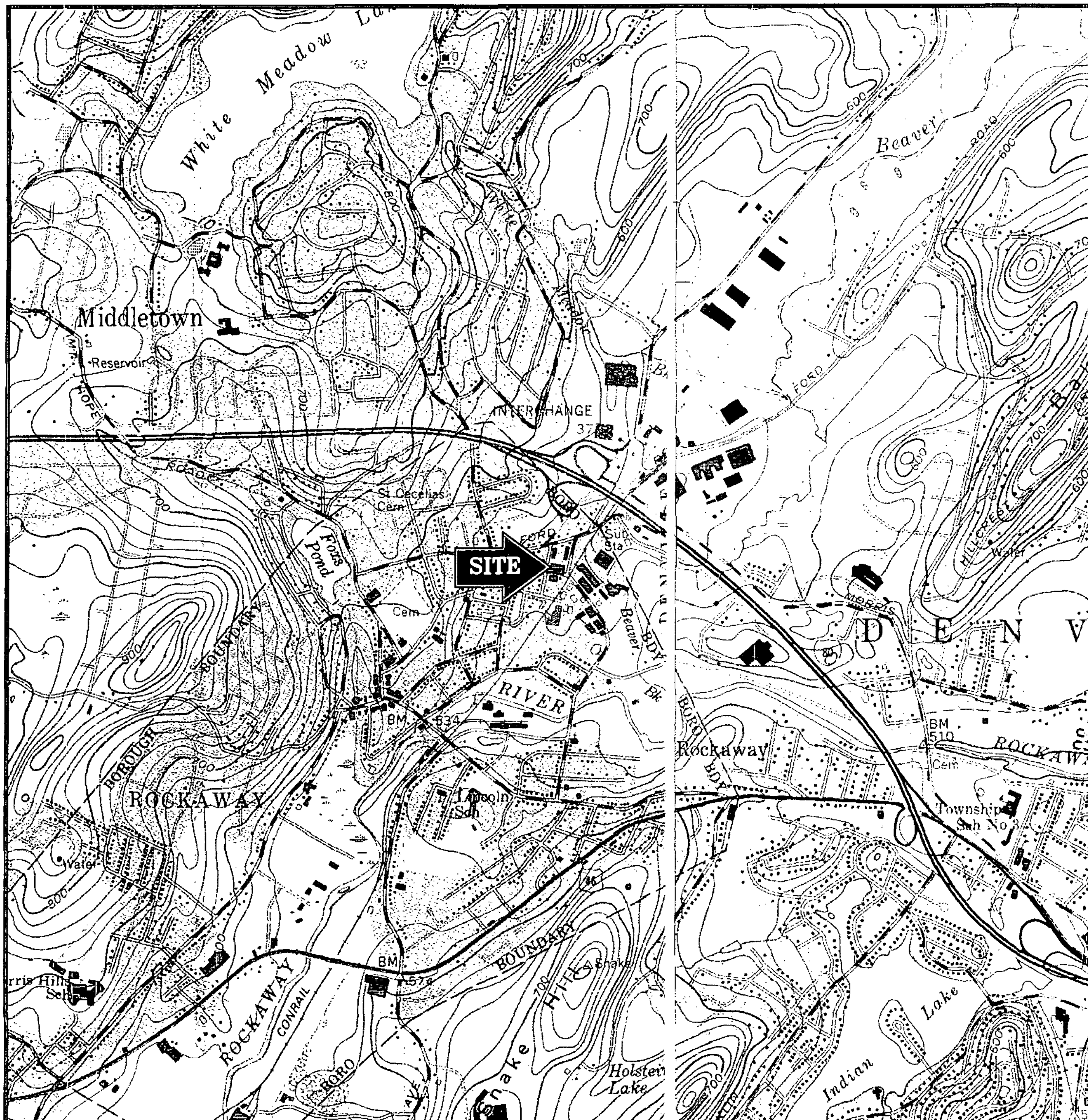
Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction Interim Guidance, EPA/540/2-91/019A September 1991

Feasibility Study analysis for CERCLA Municipal Landfill Sites, EPA 5540/R-94/081, August 1994

Federal Remediation Technologies Roundtable (FRTR), Remediation Technologies Screening Matrix & Reference Guide, Version 4.0

Environmental Security Technology Certification Program Impact of Landfill Closure Design on Long Term Attenuation of Chlorinated Hydrocarbons, March 2002

FIGURES



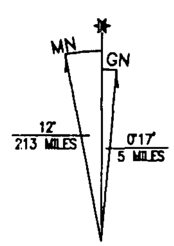
SCALE 1:24000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

.5 .25 0 .5 KILOMETER

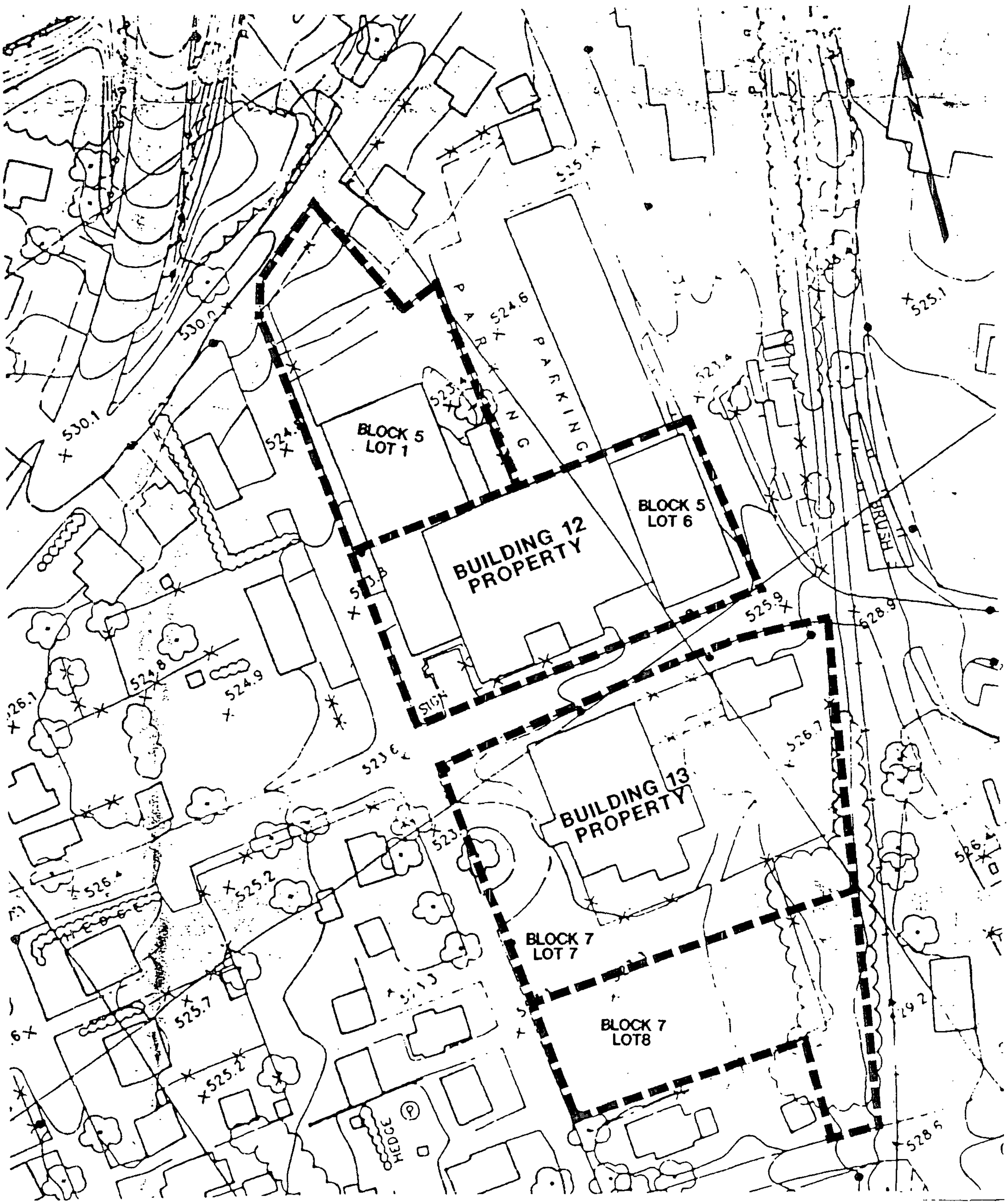
307267



UTM GRID AND 1981 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

THE WHITMAN CompanieS, INC.	KLOCKNER & KLOCKNER PROPERTY ROCKAWAY BOROUGH MORRIS COUNTY, NEW JERSEY	
	SITE LOCATION ON USGS DOVER, N.J. QUADRANGLE	
ORIGINAL BY: C.C.	DRAWN BY: R.R.	DRAWING NO: 950302MAP
CHECKED BY: B.U.	DATE: FEB. 2005	FIGURE NO: 1



SOURCE:

AERIAL SURVEY DATED JUNE 1994 PREPARED BY ROBINSON AERIAL SURVEY'S INC. FOR CONESTOGA-ROVERS & ASSOCIATES

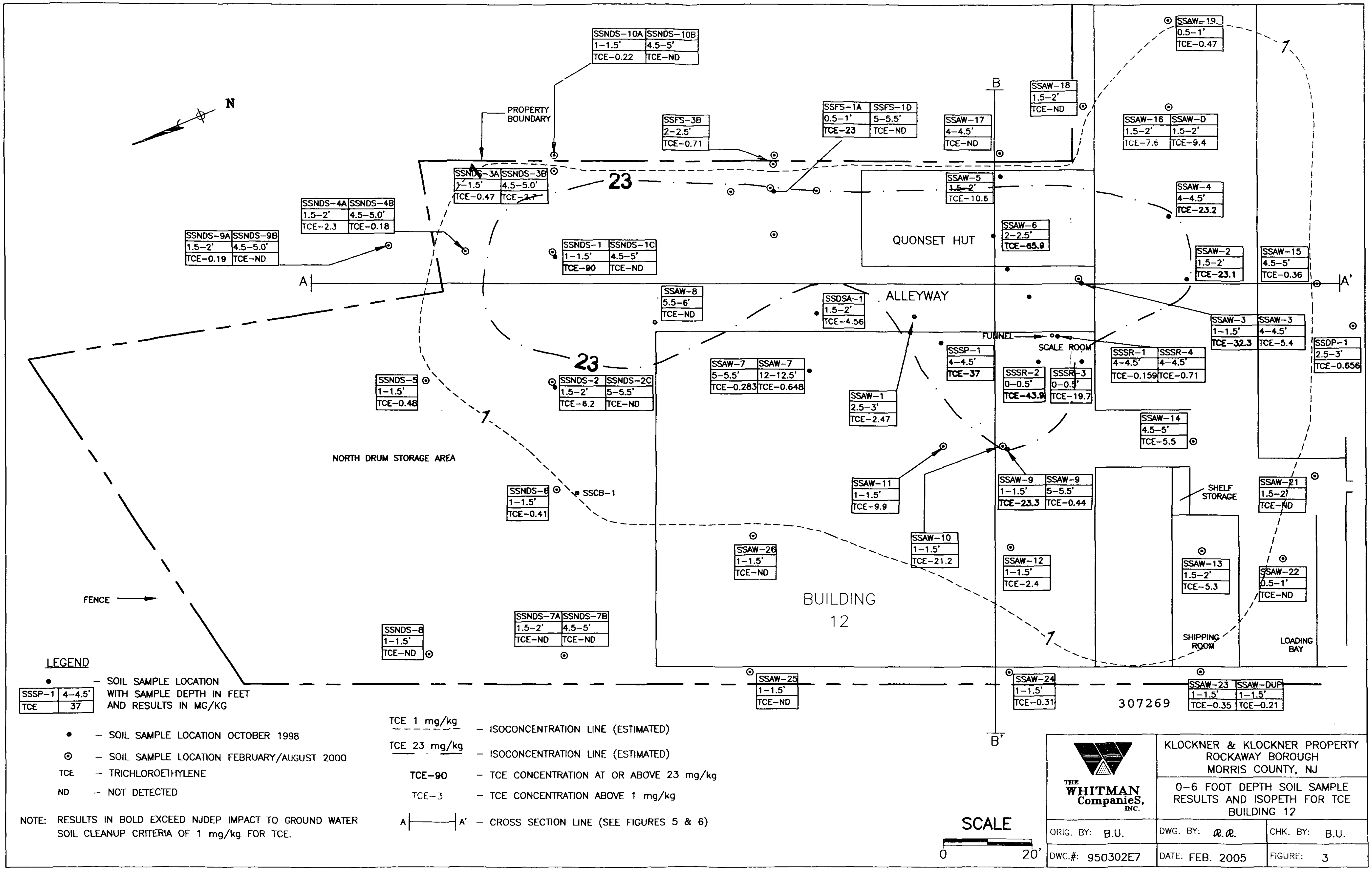
307268

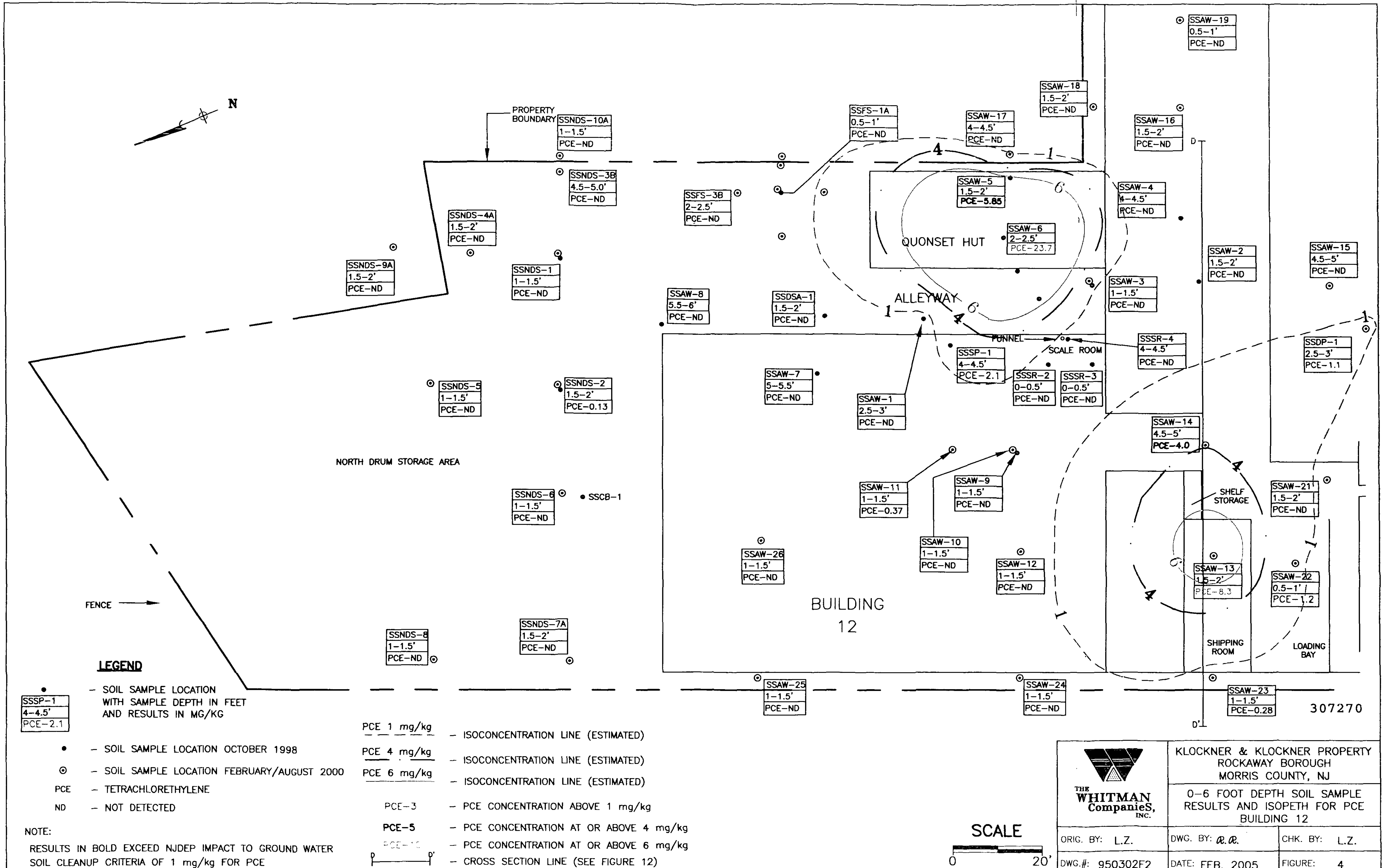
THE WHITMAN CompanieS, INC.

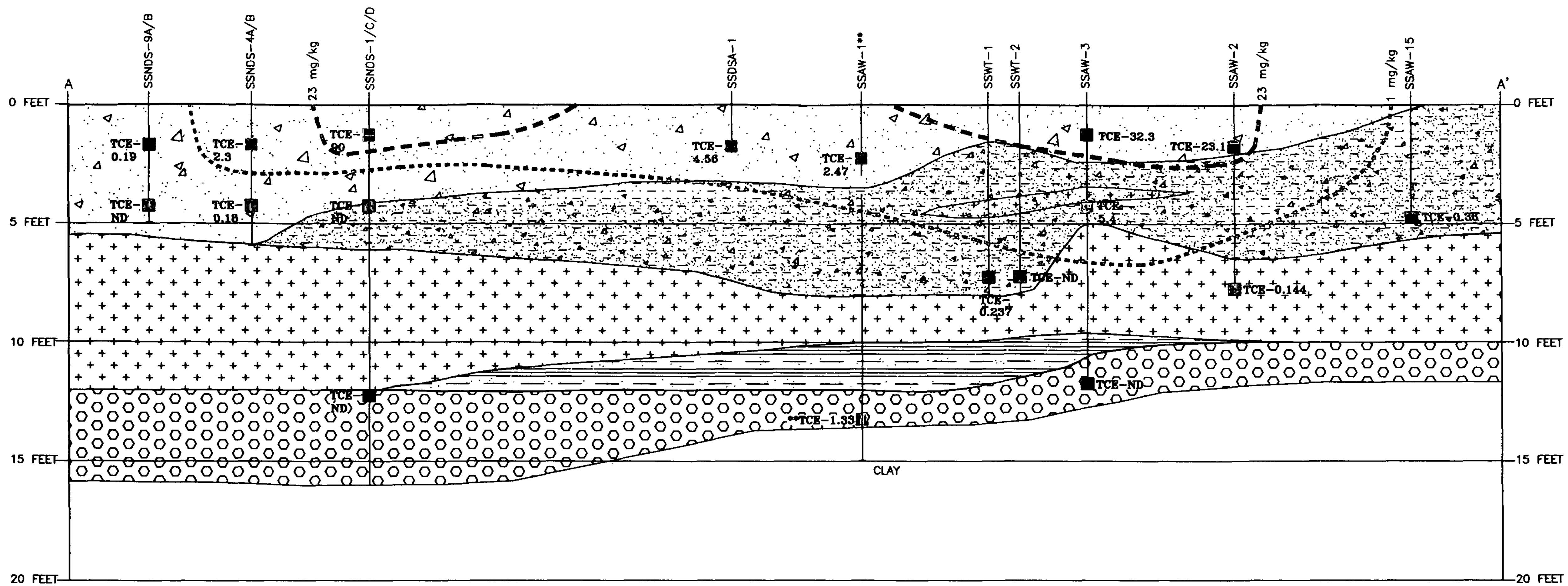
KLOCKNER & KLOCKNER PROPERTY
ROCKAWAY BOROUGH
MORRIS COUNTY, NEW JERSEY

SITE MAP OF
KLOCKNER PROPERTY

ORIGINAL BY: L.Z.	DRAWN BY: R.R.	DRAWING NO: 950302X9
CHECKED BY: B.U.	DATE: FEB. 2005	FIGURE NO: 2


N
PROPERTY BOUNDARY
SSNDS-10A 1-1.5' TCE-0.22
SSNDS-10B 4.5-5' TCE-ND
SSFS-3B 2-2.5' TCE-0.71
SSFS-1A 0.5-1' TCE-23
SSFS-1D 5-5.5' TCE-ND
SSAW-17 4-4.5' TCE-ND
SSAW-18 1.5-2' TCE-ND
SSAW-19 0.5-1' TCE-0.47
SSAW-16 1.5-2' TCE-7.6
SSAW-D 1.5-2' TCE-9.4
SSNDS-3A 1-1.5' TCE-0.47
SSNDS-3B 4.5-5.0' TCE-2.7
23
SSNDS-4A 1.5-2' TCE-2.3
SSNDS-4B 4.5-5.0' TCE-0.18
SSNDS-9A 1.5-2' TCE-0.19
SSNDS-9B 4.5-5.0' TCE-ND
SSNDS-1 1-1.5' TCE-90
SSNDS-1C 4.5-5' TCE-ND
SSAW-5 1.5-2' TCE-10.6
QUONSET HUT
SSAW-6 2-2.5' TCE-65.9
SSAW-4 4-4.5' TCE-23.2
SSAW-2 1.5-2' TCE-23.1
SSAW-15 4.5-5' TCE-0.36
A
A'
B
B'
ALLEYWAY
SSAW-8 5.5-6' TCE-ND
SSDSA-1 1.5-2' TCE-4.56
FUNNEL
SCALE ROOM
SSAW-3 1-1.5' TCE-32.3
SSAW-3 4-4.5' TCE-5.4
SSDP-1 2.5-3' TCE-0.656
SSSR-1 4-4.5' TCE-0.159
SSSR-4 4-4.5' TCE-0.71
SSSP-1 4-4.5' TCE-37
SSSR-2 0-0.5' TCE-43.9
SSSR-3 0-0.5' TCE-19.7
23
SSNDS-5 1-1.5' TCE-0.48
SSNDS-2 1.5-2' TCE-6.2
SSNDS-2C 5-5.5' TCE-ND
SSAW-7 5-5.5' TCE-0.283
SSAW-7 12-12.5' TCE-0.648
SSAW-1 2.5-3' TCE-2.47
SSAW-14 4.5-5' TCE-5.5
1
NORTH DRUM STORAGE AREA
SSNDS-6 1-1.5' TCE-0.41
SSCB-1
SSAW-11 1-1.5' TCE-9.9
SSAW-9 1-1.5' TCE-23.3
SSAW-9 5-5.5' TCE-0.44
SHELF STORAGE
SSAW-21 1.5-2' TCE-ND
SSAW-10 1-1.5' TCE-21.2
SSAW-26 1-1.5' TCE-ND
SSAW-12 1-1.5' TCE-2.4
SSAW-13 1.5-2' TCE-5.3
SSAW-22 0.5-1' TCE-ND
FENCE
BUILDING 12
SSNDS-7A 1.5-2' TCE-ND
SSNDS-7B 4.5-5' TCE-ND
SSNDS-8 1-1.5' TCE-ND
SHIPPING ROOM
LOADING BAY
SSAW-25 1-1.5' TCE-ND
SSAW-24 1-1.5' TCE-0.31
SSAW-23 1-1.5' TCE-0.35
SSAW-DUP 1-1.5' TCE-0.21
307269
LEGEND
SSSP-1 4-4.5' TCE 37 – SOIL SAMPLE LOCATION WITH SAMPLE DEPTH IN FEET AND RESULTS IN MG/KG
• – SOIL SAMPLE LOCATION OCTOBER 1998
⊙ – SOIL SAMPLE LOCATION FEBRUARY/AUGUST 2000
TCE – TRICHLOROETHYLENE
ND – NOT DETECTED
TCE 1 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)
TCE 23 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)
TCE-90 – TCE CONCENTRATION AT OR ABOVE 23 mg/kg
TCE-3 – TCE CONCENTRATION ABOVE 1 mg/kg
A–A' – CROSS SECTION LINE (SEE FIGURES 5 & 6)
NOTE: RESULTS IN BOLD EXCEED NJDEP IMPACT TO GROUND WATER SOIL CLEANUP CRITERIA OF 1 mg/kg FOR TCE.
SCALE
0
20'
THE WHITMAN CompanieS, INC.
KLOCKNER & KLOCKNER PROPERTY
ROCKAWAY BOROUGH
MORRIS COUNTY, NJ
0-6 FOOT DEPTH SOIL SAMPLE RESULTS AND ISOPETH FOR TCE BUILDING 12
ORIG. BY: B.U.
DWG. BY: R.R.
CHK. BY: B.U.
DWG.#: 950302E7
DATE: FEB. 2005
FIGURE: 3


N
PROPERTY BOUNDARY
SSNDS-10A
1-1.5'
PCE-ND
SSNDS-3B
4.5-5.0'
PCE-ND
SSNDS-4A
1.5-2'
PCE-ND
SSNDS-9A
1.5-2'
PCE-ND
SSNDS-1
1-1.5'
PCE-ND
SSFS-3B
2-2.5'
PCE-ND
SSFS-1A
0.5-1'
PCE-ND
SSAW-17
4-4.5'
PCE-ND
SSAW-18
1.5-2'
PCE-ND
SSAW-19
0.5-1'
PCE-ND
SSAW-16
1.5-2'
PCE-ND
SSAW-5
1.5-2'
PCE-5.85
SSAW-6
2-2.5'
PCE-23.7
QUONSET HUT
SSAW-4
4-4.5'
PCE-ND
SSAW-2
1.5-2'
PCE-ND
SSAW-15
4.5-5'
PCE-ND
SSAW-3
1-1.5'
PCE-ND
ALLEYWAY
SSAW-8
5.5-6'
PCE-ND
SSDSA-1
1.5-2'
PCE-ND
FUNNEL
SCALE ROOM
SSSR-4
4-4.5'
PCE-ND
SSDP-1
2.5-3'
PCE-1.1
SSSP-1
4-4.5'
PCE-2.1
SSSR-2
0-0.5'
PCE-ND
SSSR-3
0-0.5'
PCE-ND
SSAW-7
5-5.5'
PCE-ND
SSAW-1
2.5-3'
PCE-ND
SSNDS-5
1-1.5'
PCE-ND
SSNDS-2
1.5-2'
PCE-0.13
NORTH DRUM STORAGE AREA
SSAW-14
4.5-5'
PCE-4.0
SSAW-11
1-1.5'
PCE-0.37
SSAW-9
1-1.5'
PCE-ND
SHELF STORAGE
SSAW-21
1.5-2'
PCE-ND
SSNDS-6
1-1.5'
PCE-ND
SSCB-1
SSAW-10
1-1.5'
PCE-ND
SSAW-26
1-1.5'
PCE-ND
SSAW-12
1-1.5'
PCE-ND
SSAW-13
1.5-2'
PCE-8.3
SSAW-22
0.5-1'
PCE-1.2
FENCE
BUILDING 12
SHIPPING ROOM
LOADING BAY
SSNDS-8
1-1.5'
PCE-ND
SSNDS-7A
1.5-2'
PCE-ND
SSAW-25
1-1.5'
PCE-ND
SSAW-24
1-1.5'
PCE-ND
SSAW-23
1-1.5'
PCE-0.28
D
D'
307270
LEGEND
SSSP-1
4-4.5'
PCE-2.1
- SOIL SAMPLE LOCATION WITH SAMPLE DEPTH IN FEET AND RESULTS IN MG/KG
- SOIL SAMPLE LOCATION OCTOBER 1998
- SOIL SAMPLE LOCATION FEBRUARY/AUGUST 2000
PCE - TETRACHLORETHYLENE
ND - NOT DETECTED
NOTE:
RESULTS IN BOLD EXCEED NJDEP IMPACT TO GROUND WATER SOIL CLEANUP CRITERIA OF 1 mg/kg FOR PCE
PCE 1 mg/kg - ISOCONCENTRATION LINE (ESTIMATED)
PCE 4 mg/kg - ISOCONCENTRATION LINE (ESTIMATED)
PCE 6 mg/kg - ISOCONCENTRATION LINE (ESTIMATED)
PCE-3 - PCE CONCENTRATION ABOVE 1 mg/kg
PCE-5 - PCE CONCENTRATION AT OR ABOVE 4 mg/kg
PCE-12 - PCE CONCENTRATION AT OR ABOVE 6 mg/kg
D D' - CROSS SECTION LINE (SEE FIGURE 12)
SCALE
0 20'
THE WHITMAN CompanieS, INC.
KLOCKNER & KLOCKNER PROPERTY
ROCKAWAY BOROUGH
MORRIS COUNTY, NJ
0-6 FOOT DEPTH SOIL SAMPLE RESULTS AND ISOPETH FOR PCE BUILDING 12
ORIG. BY: L.Z.
DWG. BY: R.R.
CHK. BY: L.Z.
DWG.#: 950302F2
DATE: FEB. 2005
FIGURE: 4



LEGEND

- SOIL SAMPLE LOCATION WITH RESULTS IN MG/KG (SSAW-3, TCE-32.3)

TCE 1 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

TCE 23 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

- SILTY SAND AND GRAVEL
- SILTY FINE SAND
- SILTY CLAY WITH SAND AND SOME GRAVEL
- SILTY CLAY WITH SAND
- MEDIUM SAND

NOTE:
SEE FIGURE 3 FOR CROSS SECTION LOCATION

TCE – TRICHLOROETHYLENE
ND – NOT DETECTED

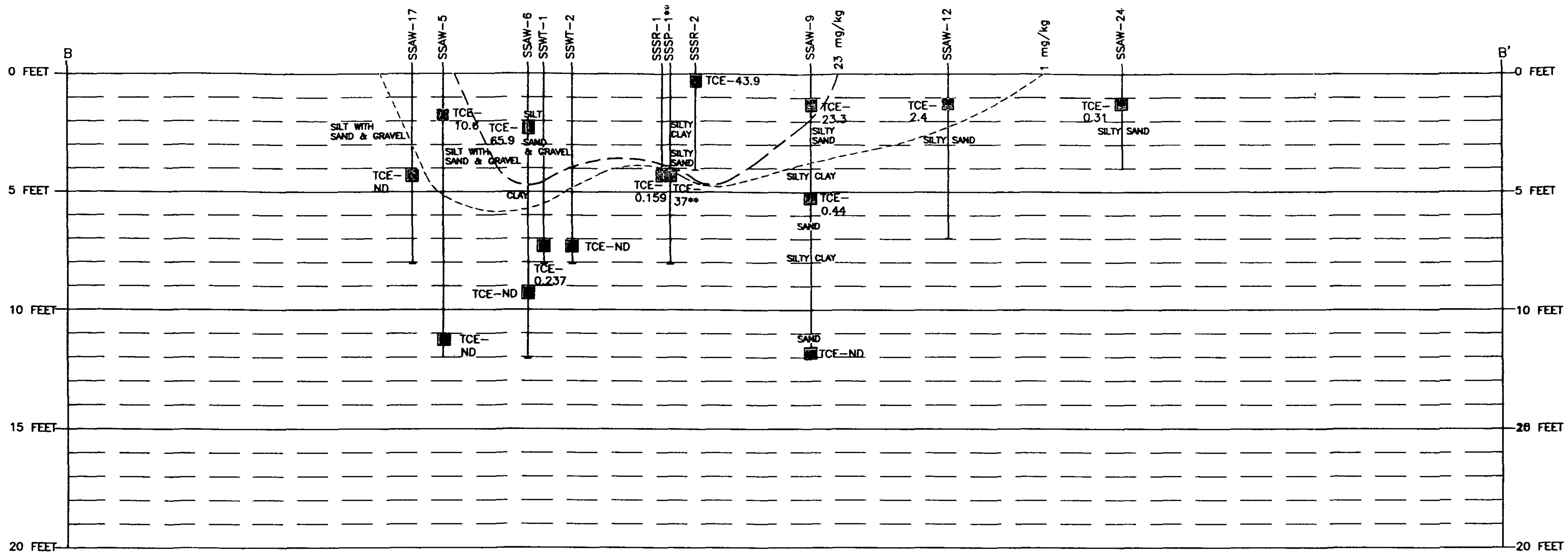
307271

0 20'
HORIZONTAL SCALE

0 5'
VERTICAL SCALE

** – THE TCE RESULT FOR SAMPLE SSAW-1 WAS NOT USED IN THE PREPARATION OF THE ISOCONCENTRATION LINES. IT IS JUST ABOVE THE NEW JERSEY IMPACT TO GROUND WATER SOIL CLEANUP CRITERIA OF 1 MG/KG AND MAY BE THE RESULT OF CONTAMINANT DIFFUSION FROM THE GROUND WATER TO THE SOIL AT THE CAPILLARY ZONE.

THE WHITMAN CompanieS, INC.	KLOCKNER & KLOCKNER PROPERTY ROCKAWAY BOROUGH MORRIS COUNTY, NEW JERSEY CROSS SECTION A-A' BUILDING 12 TCE RESULTS	
ORIGINAL BY: C.C.	DRAWN BY: R.R.	DRAWING NO: 950302E8
CHECKED BY: M.M.	DATE: FEB. 2005	FIGURE NO: 5



LEGEND

- SOIL SAMPLE LOCATION WITH RESULTS IN MG/KG

TCE 1 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

TCE 23 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

TCE-90 – TCE CONCENTRATION AT OR ABOVE 23 mg/kg

TCE-3 – TCE CONCENTRATION ABOVE 1 mg/kg

TCE – TRICHLOROETHYLENE

ND – NOT DETECTED

0 20' HORIZONTAL SCALE

0 5' VERTICAL SCALE

NOTES:

1. SEE FIGURE 3 FOR CROSS SECTION LOCATION

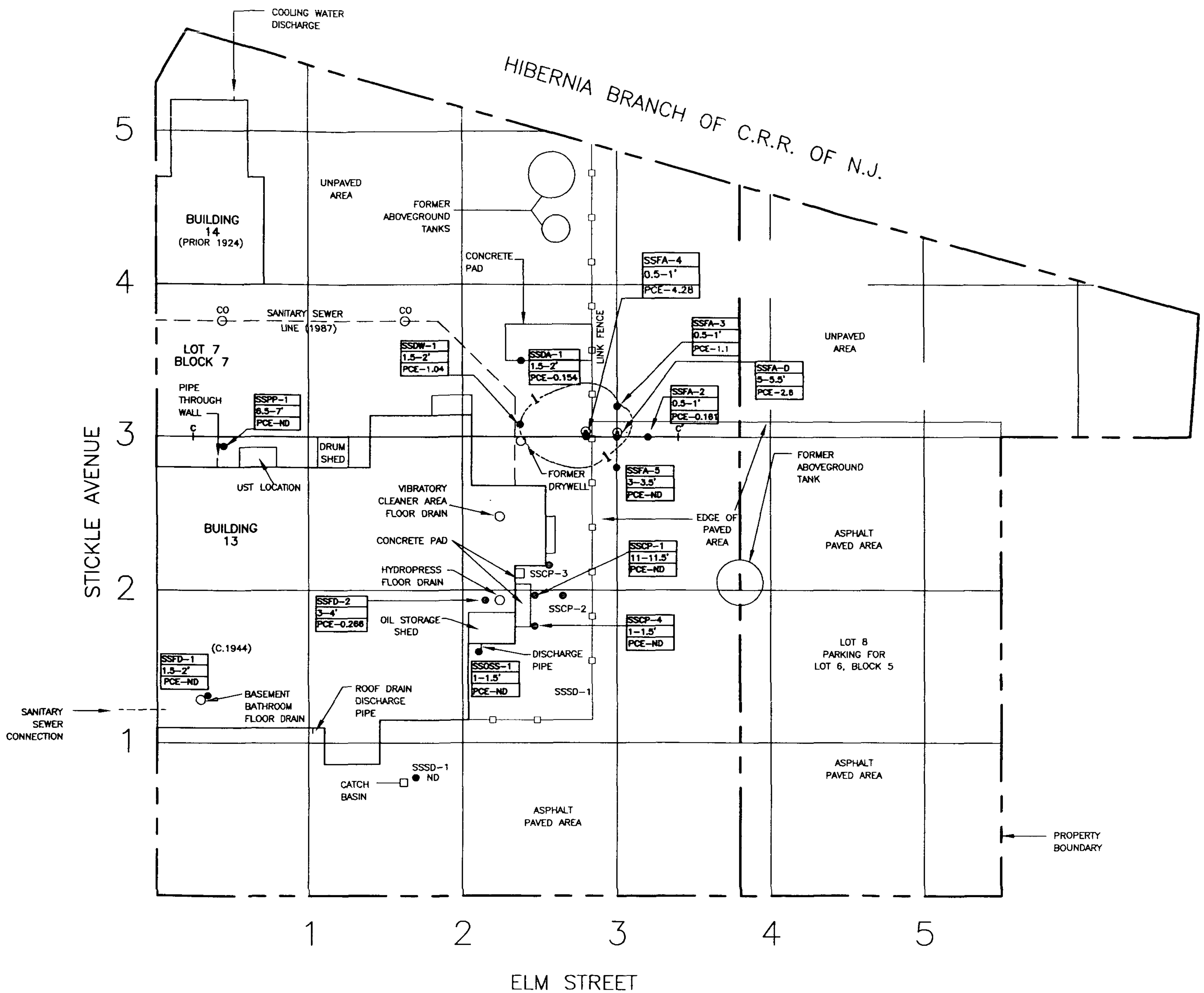
** – THE TCE RESULT FOR THE SAMPLE SSSP-1 WAS NOT USED IN THE PREPARATION OF THE ISOCONCENTRATION LINES BECAUSE THE SAMPLE WAS COLLECTED FROM BELOW THE INVERT OF A SUMP AND IS AN ANOMALY WITH RESPECT TO THE PREPARATION OF THE ISOCONCENTRATION LINES FOR THE AREA WIDE CONTAMINATION.

THE WHITMAN CompanieS, INC.

KLOCKNER & KLOCKNER PROPERTY
ROCKAWAY BOROUGH
MORRIS COUNTY, NEW JERSEY

CROSS SECTION B-B'
BUILDING 12-TCE RESULTS

ORIGINAL BY: C.C.	DRAWN BY: CLC	DRAWING NO: 950302C4
CHECKED BY: B.U.	DATE: FEB. 2005	FIGURE NO: 6



LEGEND

SSFA-4 4.28 0.5-1'	– SOIL SAMPLE LOCATION RESULTS IN MG/KG SAMPLE DEPTH
TCE	– TRICHLOROETHYLENE
PCE	– TETRACHLOROETHYLENE
ND	– NOT DETECTED
PCE 1 mg/kg	– ISOCONCENTRATION LINE (ESTIMATED)
PCE-3	– PCE CONCENTRATION ABOVE 1 mg/kg
C C'	– CROSS SECTION LINE (SEE FIGURE 8)

NOTE: RESULTS IN GREEN EXCEED NJDEP CRITERIA.

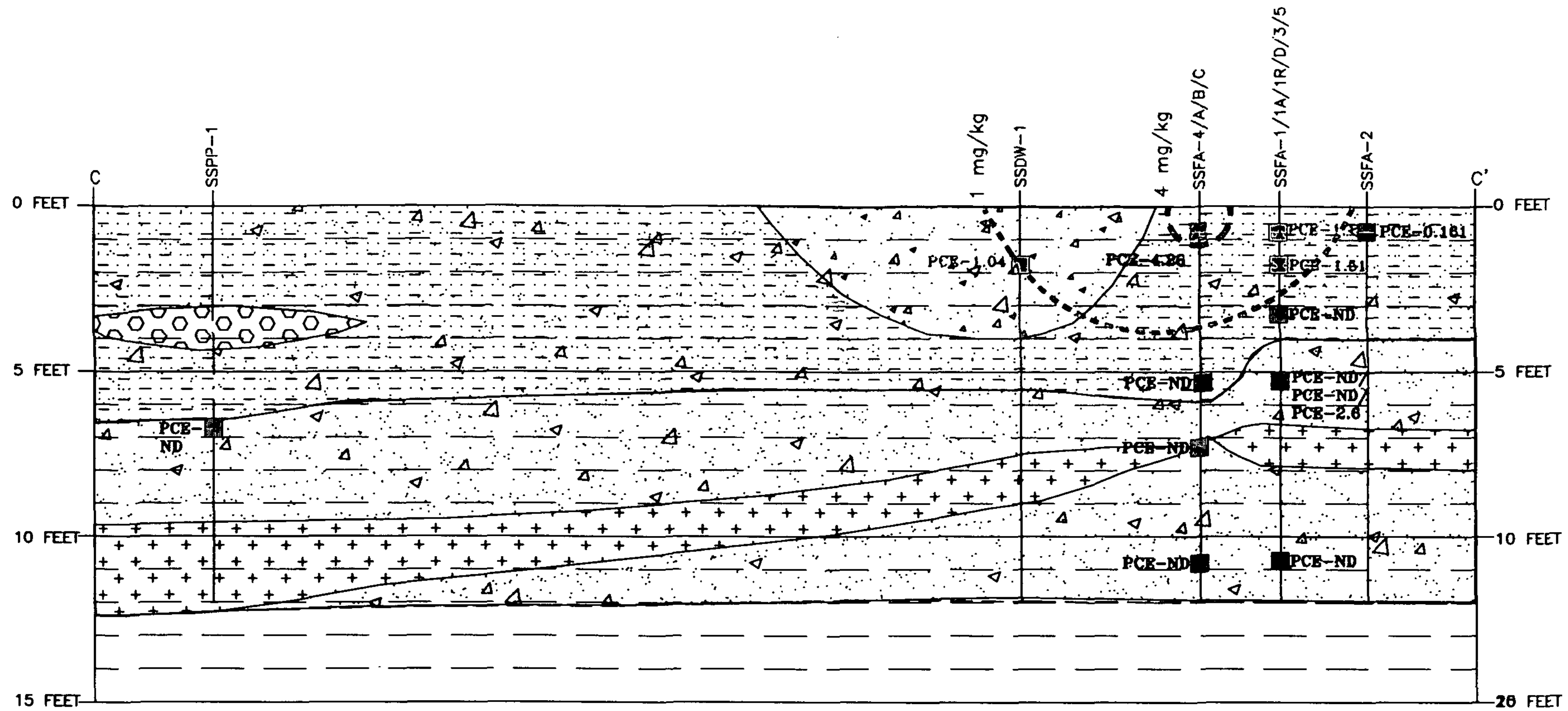
SCALE

0 40'

307273

THE WHITMAN CompanieS, INC.

KLOCKNER & KLOCKNER PROPERTY ROCKAWAY BOROUGH MORRIS COUNTY, NJ		
0-6 FOOT SOIL SAMPLE RESULTS & ISOPLETH FOR PCE – BUILDING 13		
ORIG. BY: B.U.	DWG. BY: R.R.	CHK. BY: B.U.
DWG.#: 950302F3	DATE: FEB. 2005	FIGURE: 7



LEGEND

SSFA-2 PCE-0.161 – SOIL SAMPLE LOCATION WITH RESULTS IN MG/KG

PCE – TETRACHLOROETHYLENE
ND – NOT DETECTED

PCE 1 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

PCE 4 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

PCE–4.28 – PCE CONCENTRATION AT OR ABOVE 4 mg/kg

PCE–1.51 – PCE CONCENTRATION ABOVE 1 mg/kg

NOTE:
SEE FIGURE 7 FOR CROSS SECTION LOCATION

– SILTY SAND AND GRAVEL

– SILTY FINE SAND

– SILTY CLAY WITH SAND AND SOME GRAVEL

– GRAVEL

0 20'
HORIZONTAL SCALE

0 5'
VERTICAL SCALE

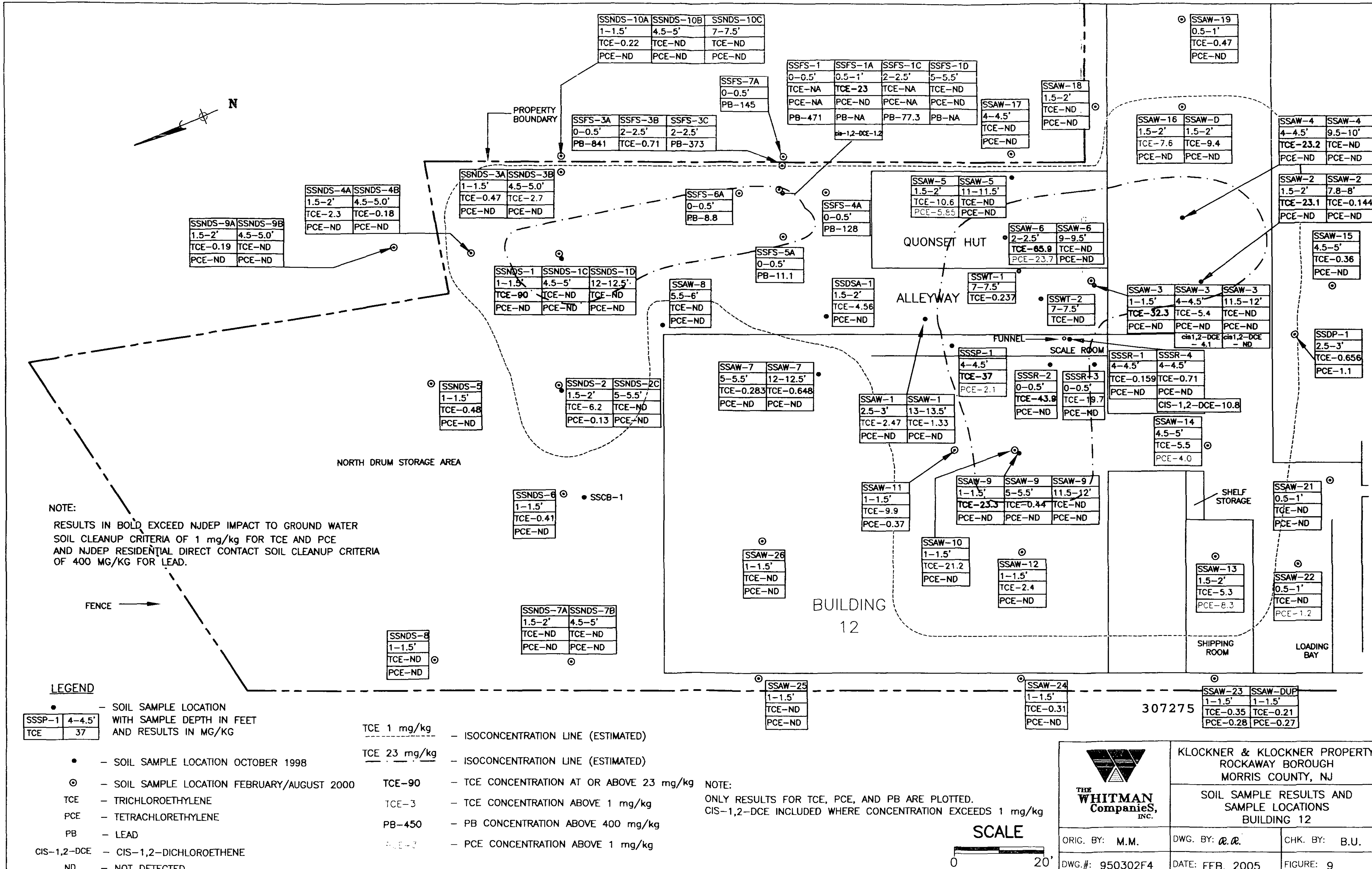
307274

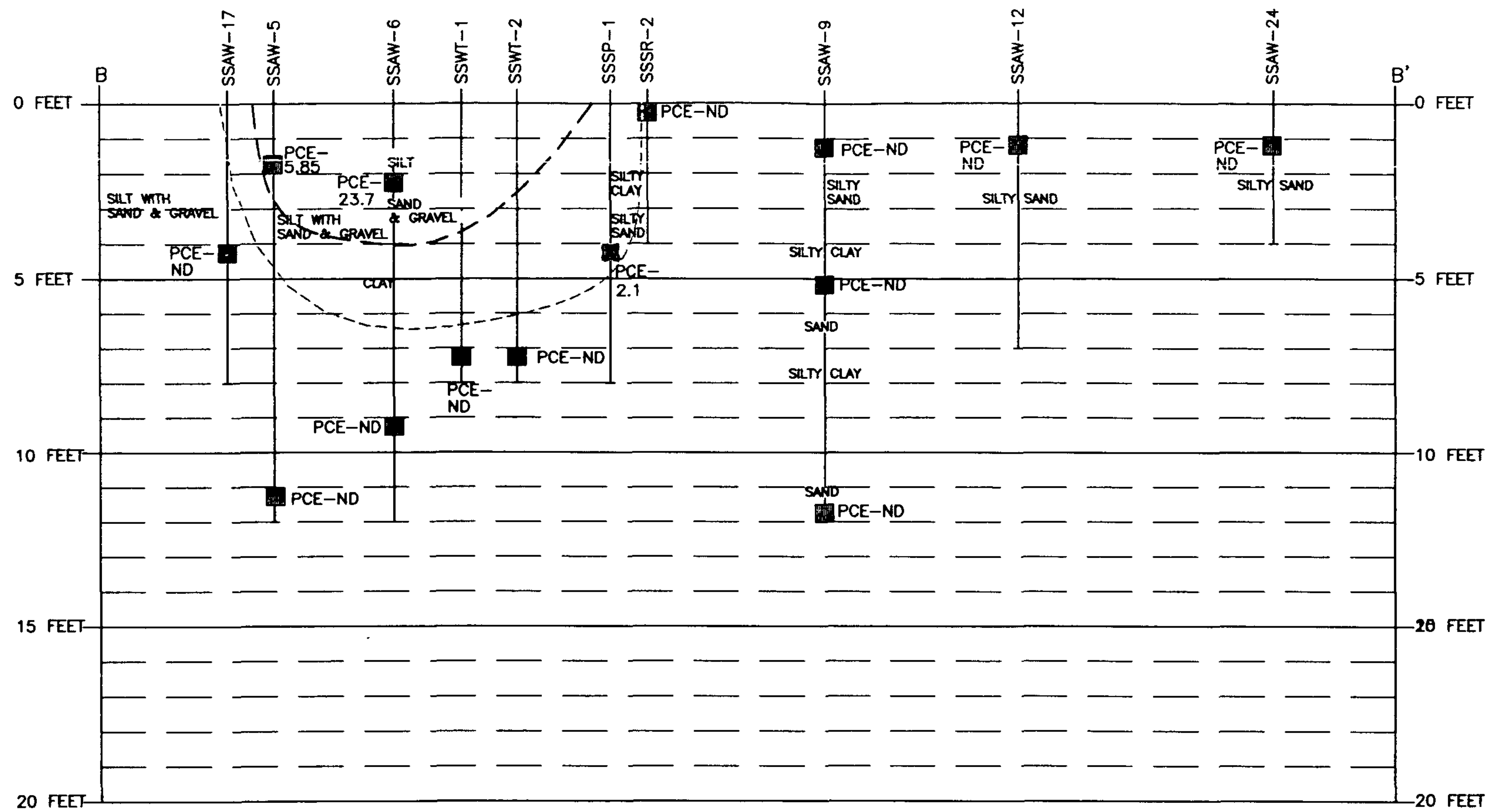
THE WHITMAN CompanieS, INC.

KLOCKNER & KLOCKNER PROPERTY
ROCKAWAY BOROUGH
MORRIS COUNTY, NEW JERSEY

CROSS SECTION C–C'
BUILDING 13

ORIGINAL BY: C.C.	DRAWN BY: CLC	DRAWING NO: 950302E5
CHECKED BY: M.M.	DATE: AUGUST 2004	FIGURE NO: 8


N
PROPERTY BOUNDARY
SSNDS-10A 1-1.5' TCE-0.22 PCE-ND
SSNDS-10B 4.5-5' TCE-ND PCE-ND
SSNDS-10C 7-7.5' TCE-ND PCE-ND
SSFS-7A 0-0.5' PB-145
SSFS-1 0-0.5' TCE-NA PCE-NA PB-471
SSFS-1A 0.5-1' TCE-23 PCE-ND PB-NA cis-1,2-DCE-1.2
SSFS-1C 2-2.5' TCE-NA PCE-NA PB-77.3
SSFS-1D 5-5.5' TCE-ND PCE-ND PB-NA
SSAW-17 4-4.5' TCE-ND PCE-ND
SSAW-18 1.5-2' TCE-ND PCE-ND
SSAW-19 0.5-1' TCE-0.47 PCE-ND
SSAW-16 1.5-2' TCE-7.6 PCE-ND
SSAW-D 1.5-2' TCE-9.4 PCE-ND
SSAW-4 4-4.5' TCE-23.2 PCE-ND
SSAW-4 9.5-10' TCE-ND PCE-ND
SSAW-2 1.5-2' TCE-23.1 PCE-ND
SSAW-2 7.8-8' TCE-0.144 PCE-ND
SSAW-15 4.5-5' TCE-0.36 PCE-ND
SSFS-3A 0-0.5' PB-841
SSFS-3B 2-2.5' TCE-0.71
SSFS-3C 2-2.5' PB-373
SSNDS-3A 1-1.5' TCE-0.47 PCE-ND
SSNDS-3B 4.5-5.0' TCE-2.7 PCE-ND
SSNDS-4A 1.5-2' TCE-2.3 PCE-ND
SSNDS-4B 4.5-5.0' TCE-0.18 PCE-ND
SSNDS-9A 1.5-2' TCE-0.19 PCE-ND
SSNDS-9B 4.5-5.0' TCE-ND PCE-ND
SSFS-6A 0-0.5' PB-8.8
SSFS-4A 0-0.5' PB-128
SSAW-5 1.5-2' TCE-10.6 PCE-5.85
SSAW-5 11-11.5' TCE-ND PCE-ND
QUONSET HUT
SSAW-6 2-2.5' TCE-65.9 PCE-23.7
SSAW-6 9-9.5' TCE-ND PCE-ND
SSFS-5A 0-0.5' PB-11.1
SSNDS-1 1-1.5' TCE-90 PCE-ND
SSNDS-1C 4.5-5' TCE-ND PCE-ND
SSNDS-1D 12-12.5' TCE-ND PCE-ND
SSAW-8 5.5-6' TCE-ND PCE-ND
SSDSA-1 1.5-2' TCE-4.56 PCE-ND
ALLEYWAY
SSWT-1 7-7.5' TCE-0.237
SSWT-2 7-7.5' TCE-ND
SSAW-3 1-1.5' TCE-32.3 PCE-ND
SSAW-3 4-4.5' TCE-5.4 PCE-ND cis1,2-DCE-4.1
SSAW-3 11.5-12' TCE-ND PCE-ND cis1,2-DCE-ND
SSDP-1 2.5-3' TCE-0.656 PCE-1.1
FUNNEL
SCALE ROOM
SSSP-1 4-4.5' TCE-37 PCE-2.1
SSSR-1 4-4.5' TCE-0.159 PCE-ND
SSSR-4 4-4.5' TCE-0.71 PCE-ND CIS-1,2-DCE-10.8
SSSR-2 0-0.5' TCE-43.9 PCE-ND
SSSR-3 0-0.5' TCE-19.7 PCE-ND
SSAW-7 5-5.5' TCE-0.283 PCE-ND
SSAW-7 12-12.5' TCE-0.648 PCE-ND
SSAW-1 2.5-3' TCE-2.47 PCE-ND
SSAW-1 13-13.5' TCE-1.33 PCE-ND
SSAW-14 4.5-5' TCE-5.5 PCE-4.0
SSNDS-5 1-1.5' TCE-0.48 PCE-ND
SSNDS-2 1.5-2' TCE-6.2 PCE-0.13
SSNDS-2C 5-5.5' TCE-ND PCE-ND
NORTH DRUM STORAGE AREA
SSAW-11 1-1.5' TCE-9.9 PCE-0.37
SSAW-9 1-1.5' TCE-23.3 PCE-ND
SSAW-9 5-5.5' TCE-0.44 PCE-ND
SSAW-9 11.5-12' TCE-ND PCE-ND
SHELF STORAGE
SSAW-21 0.5-1' TCE-ND PCE-ND
SSNDS-6 1-1.5' TCE-0.41 PCE-ND
SSCB-1
SSAW-10 1-1.5' TCE-21.2 PCE-ND
SSAW-26 1-1.5' TCE-ND PCE-ND
SSAW-12 1-1.5' TCE-2.4 PCE-ND
SSAW-13 1.5-2' TCE-5.3 PCE-8.3
SSAW-22 0.5-1' TCE-ND PCE-1.2
BUILDING 12
FENCE
SSNDS-7A 1.5-2' TCE-ND PCE-ND
SSNDS-7B 4.5-5' TCE-ND PCE-ND
SSNDS-8 1-1.5' TCE-ND PCE-ND
SHIPPING ROOM
LOADING BAY
SSAW-25 1-1.5' TCE-ND PCE-ND
SSAW-24 1-1.5' TCE-0.31 PCE-ND
SSAW-23 1-1.5' TCE-0.35 PCE-0.28
SSAW-DUP 1-1.5' TCE-0.21 PCE-0.27
307275
NOTE:
RESULTS IN BOLD EXCEED NJDEP IMPACT TO GROUND WATER SOIL CLEANUP CRITERIA OF 1 mg/kg FOR TCE AND PCE AND NJDEP RESIDENTIAL DIRECT CONTACT SOIL CLEANUP CRITERIA OF 400 MG/KG FOR LEAD.
LEGEND
• – SOIL SAMPLE LOCATION
SSSP-1 4-4.5' TCE 37 – WITH SAMPLE DEPTH IN FEET AND RESULTS IN MG/KG
• – SOIL SAMPLE LOCATION OCTOBER 1998
⊙ – SOIL SAMPLE LOCATION FEBRUARY/AUGUST 2000
TCE – TRICHLOROETHYLENE
PCE – TETRACHLORETHYLENE
PB – LEAD
CIS-1,2-DCE – CIS-1,2-DICHLOROETHENE
ND – NOT DETECTED
TCE 1 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)
TCE 23 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)
TCE-90 – TCE CONCENTRATION AT OR ABOVE 23 mg/kg
TCE-3 – TCE CONCENTRATION ABOVE 1 mg/kg
PB-450 – PB CONCENTRATION ABOVE 400 mg/kg
– PCE CONCENTRATION ABOVE 1 mg/kg
NOTE:
ONLY RESULTS FOR TCE, PCE, AND PB ARE PLOTTED.
CIS-1,2-DCE INCLUDED WHERE CONCENTRATION EXCEEDS 1 mg/kg
SCALE
0 20'
THE WHITMAN CompanieS, INC.
KLOCKNER & KLOCKNER PROPERTY
ROCKAWAY BOROUGH
MORRIS COUNTY, NJ
SOIL SAMPLE RESULTS AND SAMPLE LOCATIONS BUILDING 12
ORIG. BY: M.M.
DWG. BY: R.R.
CHK. BY: B.U.
DWG.#: 950302F4
DATE: FEB. 2005
FIGURE: 9



307276

LEGEND

SSAW-5 – SOIL SAMPLE LOCATION WITH RESULTS IN MG/KG

PCE-5.85

PCE 1 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

PCE 4 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

PCE-23.7 – PCE CONCENTRATION AT OR ABOVE 4 mg/kg

PCE-2.1 – PCE CONCENTRATION ABOVE 1 mg/kg

PCE – TETRACHLOROETHYLENE

ND – NOT DETECTED

0 20'

HORIZONTAL SCALE

0 5'

VERTICAL SCALE

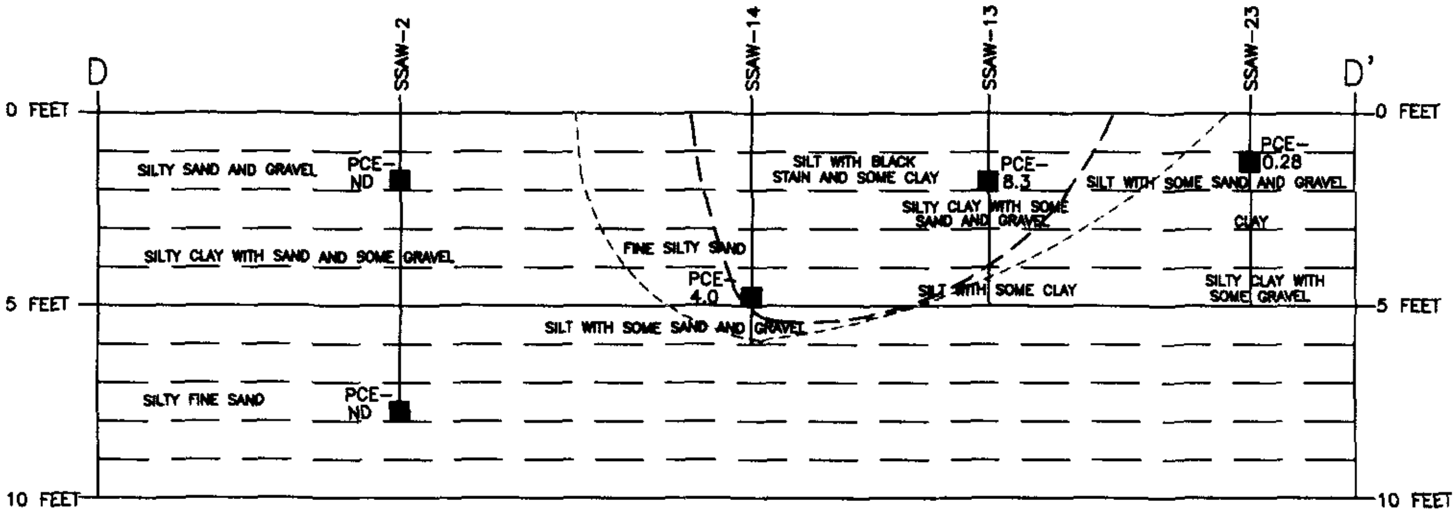
NOTE: SEE FIGURE 3 FOR CROSS SECTION LOCATION

THE WHITMAN CompanieS, INC.

KLOCKNER & KLOCKNER PROPERTY
ROCKAWAY BOROUGH
MORRIS COUNTY, NEW JERSEY

CROSS SECTION B-B'
BUILDING 12 – PCE RESULTS

ORIGINAL BY: L.Z.	DRAWN BY: R.R.	DRAWING NO: 950302F5
CHECKED BY: L.Z.	DATE: FEBRUARY 2005	FIGURE NO: 10



LEGEND

PCE 1 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

PCE 4 mg/kg – ISOCONCENTRATION LINE (ESTIMATED)

PCE-8.3 – PCE CONCENTRATION AT OR ABOVE 4 mg/kg

PCE – TETRACHLOROETHYLENE

ND – NOT DETECTED

SSAW-23 PCE-0.28 – SOIL SAMPLE LOCATION WITH RESULTS IN MG/KG

NOTE: SEE FIGURE 4 FOR CROSS SECTION LOCATION

VERTICAL SCALE 0 5'

HORIZONTAL SCALE 0 20'

307277

THE WHITMAN Companies, INC.

KLOCKNER & KLOCKNER PROPERTY
ROCKAWAY BOROUGH
MORRIS COUNTY, NEW JERSEY

CROSS SECTION D–D'
BUILDING 12 – PCE RESULTS

ORIGINAL BY: L.Z.	DRAWN BY: a.a.	DRAWING NO: 950302F1
CHECKED BY: L.Z.	DATE: FEBRUARY 2005	FIGURE NO: 11

ATTACHMENTS

307278

ATTACHMENT 1

DEPTH TO GROUND WATER INFORMATION

307280

TABLE 1

KLOCKNER & KLOCKNER

SHALLOW GROUND WATER ELEVATIONS MEASURED BY KLOCKNER'S CONSULTANTS

Monitoring Well	Top of Casing (feet, MSL)	Ground Surface Elevation (feet, MSL)	8/7/87		9/29/87		12/14/88		9/27/89		10/26/89		11/13/89		Range (feet)	Fluctuation (feet)
			Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)		
MW-1S	523.40	523.8	510.19	13.61	510.51	13.29	509.38	14.42	511.03	12.77	511.54	12.26	511.48	12.32	12.26-14.42	2.16
MW-2S	525.29	523.0	510.46	12.54	510.78	12.22	509.54	13.46	511.26	11.74	511.58	11.42	511.61	11.39	11.39-13.46	2.04
MW-3S	524.71	523.2	510.51	12.69	510.80	12.40	509.59	13.61	511.29	11.91	511.66	11.54	511.63	11.57	11.54-13.61	2.07
MW-4S	522.63	523.0	-	-	-	-	-	-	511.95	11.05	511.69	11.31	511.69	11.31	11.05-11.31	0.26
MW-5S	522.86	523.2	-	-	-	-	509.69	13.51	511.24	11.96	511.72	11.48	511.64	11.56	11.48-13.51	2.03
MW-6S	522.45	522.6	-	-	-	-	509.74	12.86	511.21	11.39	511.72	10.88	511.64	10.96	10.88-12.86	1.98
MW-7S	522.87	523.4	-	-	-	-	-	-	511.33	12.07	511.63	11.77	511.57	11.83	11.77-12.07	0.3
P-1	525.35	522.8	-	-	-	-	-	-	511.29	11.51	511.55	11.25	511.58	11.22	11.22-11.51	0.29

Key

MSL - Mean Sea Level

Note: All wells listed are located on the Building 12 property.

F:\WPDOCS\MISC\950302.622

TABLE 2

KLOCKNER & KLOCKNER

SHALLOW GROUND WATER ELEVATIONS *

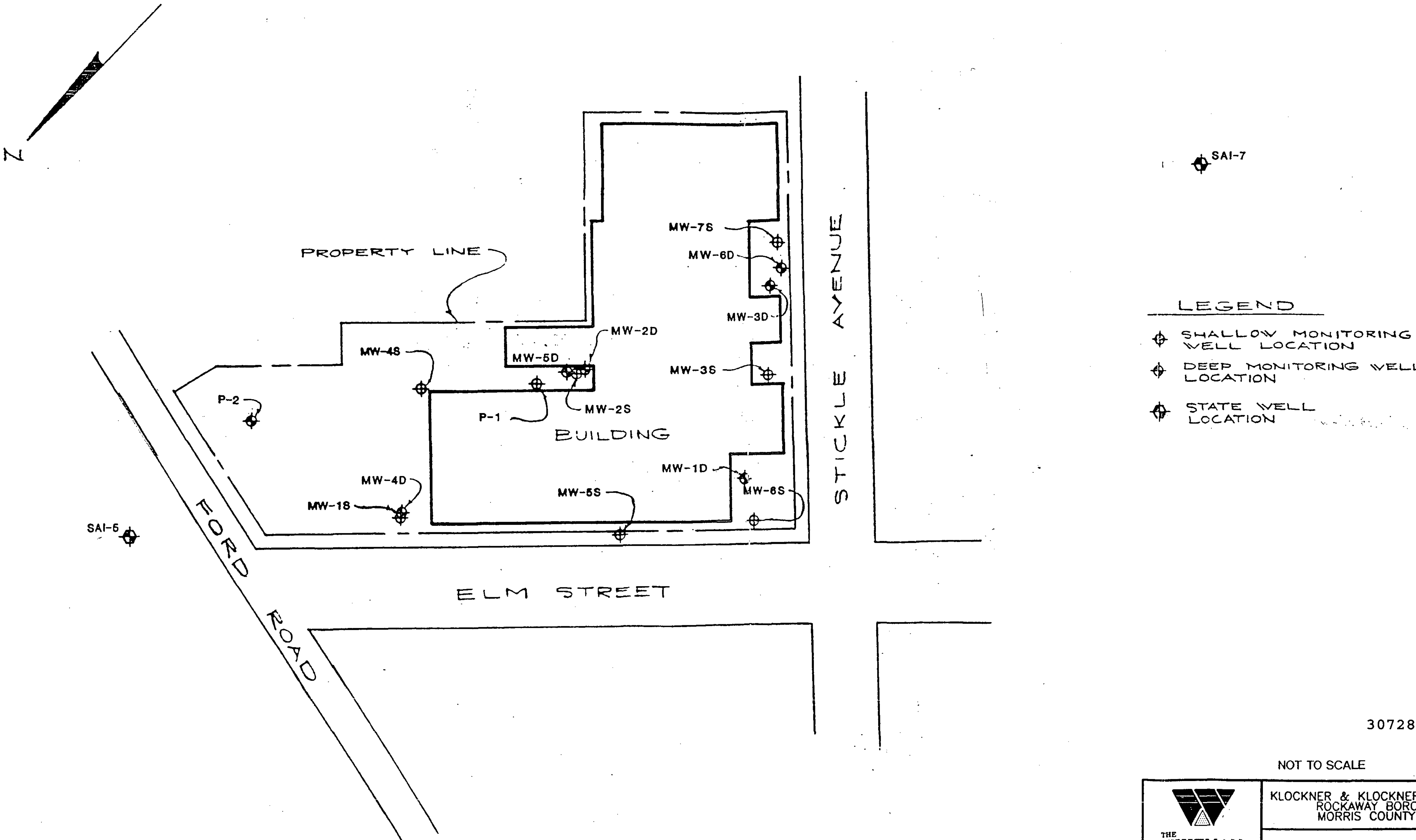
Monitoring Well	Top of Casing (feet, MSL)	Ground Surface Elevation (feet, MSL)	10/4/89		9/11/90-9/14/90		9/24/90-9/27/90		10/8/90		10/9/90		10/10/90		11/16/90		12/20/90		1/16/91		Range (feet)	Fluctuation (feet)
			Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)	Water Table Elevation (feet, MSL)	Depth Below Grade (feet)		
MW-1S	524.09	524.48	511.59	12.89	511.79	12.69	-	-	510.77	13.71	510.74	13.74	510.71	13.77	510.69	13.79	511.23	13.25	511.59	12.89	12.69-13.79	1.10
MW-2S	525.97	523.81	512.57	11.24	511.77	12.04	-	-	511.42	12.39	511.39	12.42	511.37	12.44	511.29	12.52	511.47	12.34	511.82	10.99	10.99-12.52	1.53
MW-3S	525.39	523.94	512.01	11.93	510.99	12.95	-	-	511.46	12.48	511.41	12.53	511.40	12.54	511.30	12.64	511.51	12.43	511.83	12.11	11.93-12.95	1.02
MW-4S	523.31	523.68	-	-	511.81	11.87	-	-	511.43	12.25	511.69	11.99	511.85	11.83	511.43	12.25	511.93	11.75	512.53	11.15	11.15-12.25	1.10
MW-5S	523.38	523.87	-	-	511.96	11.91	-	-	511.40	12.47	511.40	12.47	511.37	12.50	511.29	12.58	511.51	12.36	511.86	12.01	11.91-12.58	0.67
MW-6S	522.99	523.26	-	-	511.99	11.27	-	-	511.40	11.86	511.37	11.89	511.36	11.90	511.29	11.97	511.52	11.74	511.84	11.42	11.27-11.97	0.70
MW-7S	523.56	524.05	-	-	511.86	12.19	-	-	511.37	12.68	511.34	12.71	511.32	12.73	511.22	12.83	511.43	12.62	511.77	12.58	12.19-12.83	0.64
FG-1	524.04	524.66	-	-	-	-	510.84	13.82	510.62	14.04	510.58	14.08	510.56	14.10	510.43	14.23	510.73	13.93	511.09	13.57	13.57-14.23	0.66

Key

MSL - Mean Sea Level

*Information from August 1991 Feasibility Study, Rockaway Borough Well Field Site, Tables 1-1 and 1-2 by ICF Technology Incorporated

Note: Monitoring well FG-1 is located on the Building 13 property. All other wells listed are located on the Building 12 property.

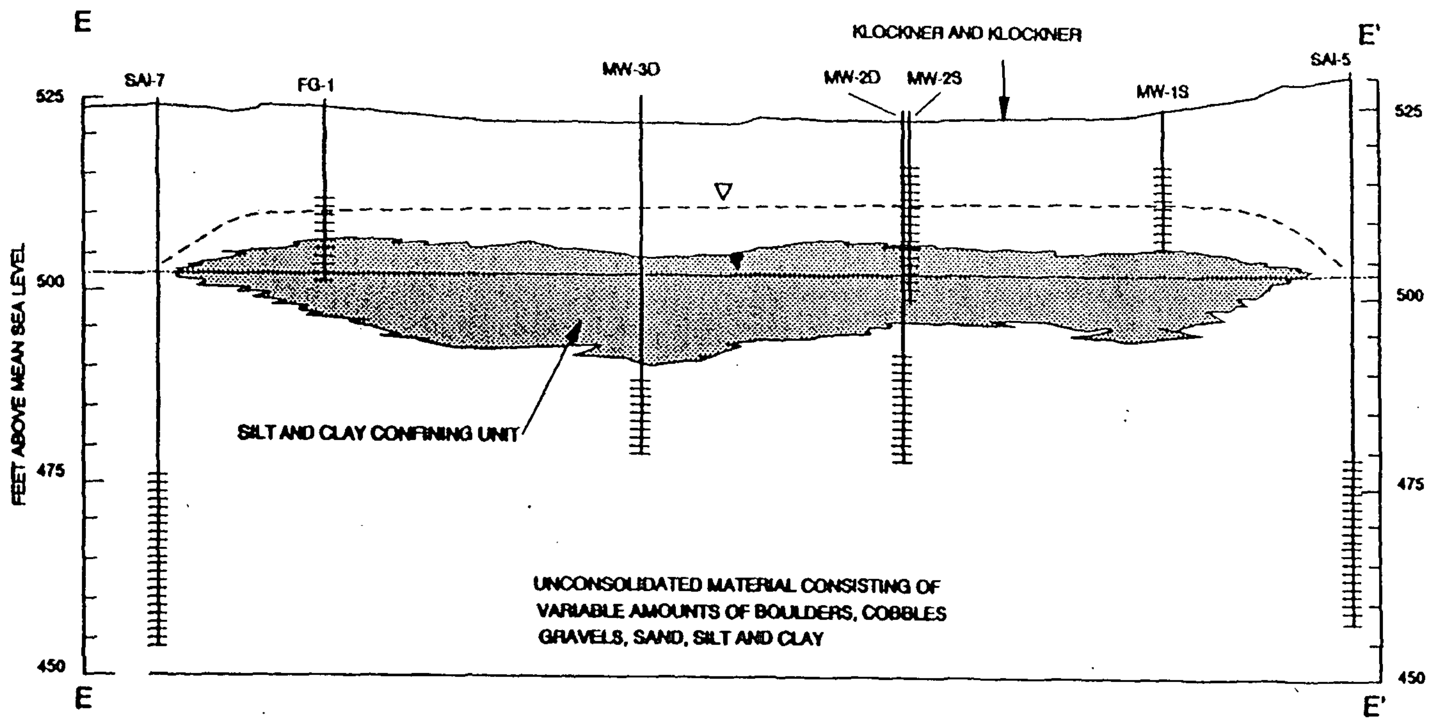


307283

NOT TO SCALE

THE WHITMAN CompanieS, INC.	KLOCKNER & KLOCKNER PROPERTY ROCKAWAY BOROUGH MORRIS COUNTY, NJ	
	MONITORING WELL LOCATIONS	
ORIG. BY: MM	DWG. BY: A. Villar	CHK. BY: MM
DWG.#:	DATE: NOV. 1995	FIGURE: 3.12

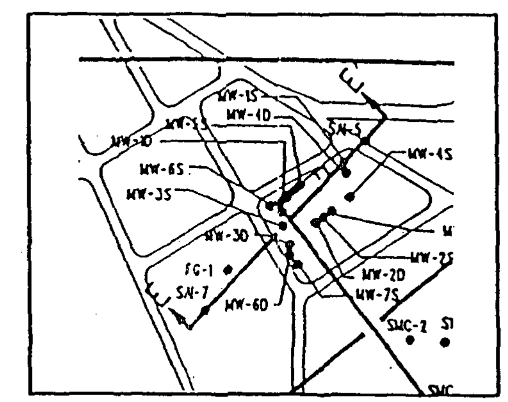
SOURCE: FIRST ENVIRONMENT



LEGEND

APPROXIMATE HORIZONTAL SCALE
1 INCH = 100 FEET

PERCHED WATER TABLE
INFERRED GROUNDWATER TABLE
MONITORING WELL AND SCREENED INTERVAL



CROSS-SECTION LOCATION
NOT TO SCALE

307284

SOURCE: ICM, 1991

THE WHITMAN CompanieS, INC.	KLOCKNER & KLOCKNER PROPERTY ROCKAWAY BOROUGH MORRIS COUNTY, NJ	
	GEOLOGIC AND HYDROGEOLOGIC CROSS SECTION	
ORIG. BY: MM	DWG. BY: A. Villar	CHK. BY: MM
DWG.#:	DATE: NOV. 1995	FIGURE: 2.9

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ATTACHMENT 2

EPA'S JANUARY 20, 2005 LETTER

307286

Klockner
Metlitz

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
290 BROADWAY
NEW YORK, NEW YORK 10007

JAN 20 2005

EXPRESS MAIL
RETURN RECEIPT REQUESTED

RECEIVED
JAN 26 2005
The Whitman Companies, Inc.

Mr. Michael Metlitz
116 Tices Lane
Unit B-1
East Brunswick, New Jersey 08816

Re: Technical Memorandum for the Development and Screening of Alternatives for Site Remediation for the Rockaway Borough Wellfield Superfund Site, Morris County, New Jersey

Dear Mr. Metlitz:

The U.S. Environmental Protection Agency (EPA) and New Jersey Department of Environmental Protection have reviewed the Whitman Companies' September 16, 2004 Technical Memorandum for the Development and Screening of Alternatives for Site Remediation for the Klockner and Klockner portion of the Rockaway Borough Wellfield site. Please address the following comments:

General Comments:

Please reference the EPA document, "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, October 1988", which details the appropriate format to arrive at a detailed analysis of appropriate alternatives. Overall the memorandum does not follow the format for the above-mentioned EPA guidance. For instance, Section 6 (Description of Remedial Technologies) and Section 7 (Initial Screening of Process Options) appear to be part of Section 5 (Identification and Screening of Remedial Alternatives).

There does not appear to be any supporting figure displaying the Cross Sections A-A' Building 12, B-B' Building 12 , and C-C' Building 12. These cross-sections should be displayed on a plan view of the respective building areas for reference by the reviewer.

There needs to be a clear division between the removal of metals and the removal of Volatile Organic Compounds. The report should have specific sections for the remedial alternatives for the removal of lead as well as removal of TCE and PCE.

Specific Comments:

1. **Table of Contents** - The numbering of Section 6.1.2 (Performance Data) and Section 6.1.3 (Cost) should be Sections 6.1.4 and 6.1.5 respectively.

2. **Section 2.2 - last paragraph, Page 4** - Need to better define what depth is considered to be saturated. A defined depth as per the 1995 Administrative Order on Consent should be represented in this memorandum.

3. **Section 4.1.2 - first paragraph, Page 5** - This paragraph describes the conclusions from the human health risk assessment and should include the summary from the risk assessment instead of paraphrasing the summary.

4. **Section 4.1.2 - Cleanup Criteria Table, Page 6** - The table in Section 4.1.2 includes a proposed cleanup concentration for lead and the basis for this proposal should be either cited or explained in this section..

5. **Section 4.3.1 - Lead Contamination, Page 6** - The New Jersey Residential Direct Contact Soil Cleanup Criteria should be cited.

6. **Section 4.3.2 - second paragraph, Page 7** - This paragraph contains vague references that are difficult to follow. For example, it mentions that the quantitation limit for some of the samples were just above the NJIGWSCC of 1 mg/kg, then it indicates that the TCE concentrations in the noted sample were all above 19 mg/kg. It is unclear which samples are the "noted samples" and the relationship between the detection limit and quantitation limit need to be better explained.

7. **Section 4.3.2 - second paragraph, Page 7** - In the last paragraph it says that "the vertical and horizontal extent of the PCE affected areas has been delineated", however, there are no cross-section figures to support this statement.

8. **Section 5.2 - Identification of Remedial Technologies and Process Options Potentially Available, Page 8** - This section includes the statement that, " The following is a list of possible remediation alternatives for the Klockner Property. These process options and how they fared in the initial screening are summarized in Section 8." Remedial Alternatives are different than remedial technologies and process options, and the statement should be corrected accordingly.

9. **Section 5.2 - Identification of Remedial Technologies and Process Options Potentially Available, Item 3, In-situ Treatment, Page 9 -** The third bullet of this item should be written "Thermal treatment combined with vapor extraction" for consistency with Table 1.

10. **Section 5.2.5 - Cost Evaluation, Page 10 -** It should be noted that, in accordance with CERCLA protocols, the cost evaluation at this stage is intended to provide a relative comparison of process options (e.g., asphalt, clay, soil) within a technology type (e.g., capping), not among all process options.

11. **Table 1, Page 11**

- The first cell "No Further Action Further Action" should read "No Action"since no action has been taken at the site. The No Action Alternative is required to be used as a baseline to compare the other alternatives and cannot be listed as not acceptable.

- The third cell "Institutional Controls" shows that process options are not applicable, however, there are institutional controls that are applicable such as, deed restriction. Please research this option more thoroughly.

- This table is intended to address TCE and PCE issues and should not include references to lead, which is the subject of Table 2.

- Process Options are referenced in the text that are not included in Table 1 (e.g., radio frequency/electromagnetic heating and bioventing).

- The format in Tables 1, 2, and 3 is confusing because CERCLA terms such as General Response Actions, Remedial Technology Categories, Process Options, and Remedial Alternatives are not utilized, presented and applied in a consistent manner nor are they in accordance with CERCLA protocols.

12. **Section 6.0 Description of the Remedial Technologies, Page 14 -** The material presented in this section should be clarified since not all remedial technologies are not discussed and the section should be renamed as the "Description of Seriously Considered Remedial Technologies" or similar.

13. **Section 6.1 - Soil Vapor Extraction, Page 15 -** The last sentence on page 15 states that, "The duration of operation and maintenance for in-situ SVE is typically medium-to-long-term." However, in Section 6.1.4 Performance Data (incorrectly numbered 6.1.2 in the document) it states that SVE projects are typically completed in 1 to 3 years. These appear to be inconsistent, as 3 years would not typically be considered a long-term remediation.

14. **Section 6.5.2 - Applicability, first bullet, Page 25 -** Please revise to indicate that there is a potential for complete destruction of PCE and TCE without the formation of harmful byproducts. In addition, please take in to account the next comment in regard to this bullet.

15. **Section 6.5.3 - Limitations, first bullet, Page 26 -** Please revise to indicate that there is a potential for incomplete oxidation or formation of intermediate contaminants that are more toxic that the original contaminants and oxidizing agents used. As mentioned in the above comment, the first bullet for the advantage and disadvantage of using in situ chemical oxidation provide conflicting information. Although both statements are true, more detail should be provided to show that detoxification occurs more frequently than the creation of more toxic degradation products, if this is true, to support the advantage classification.

16. **Section 6.5.3 - Limitations, third bullet, Page 26 -** This item refers to "...ex-situ remedy..." However, the entire section is developed for in-situ chemical oxidation.

17. **Section 6.5.6 - Cost, Page 27 -** The text indicates that the cost figures are not available for in-situ oxidation; however, Table 3, which seems to list this same response action twice, indicates this as a high cost process option.

18. **Table 3 - Screening and Elimination of Process Options, Pages 27 and 28**
 - Tables 1 and 2 were intended to evaluate Process Options, and Table 3 is intended to screen and eliminate Process Options. A number of process options that were evaluated in Tables 1 and 2 are not included in Table 3 and should be added (e.g., institutional controls, bioventing, ex-situ soil washing, etc.)

 - Either the first column in the table should be retitled Process Options or the title of the table should be changed to match the name of the first column.

 - Either the second reference to In-situ Chemical Treatment should be removed or designation as ozone or hydrogen peroxide needs to be added.

 - Table 3 shows the No Action alternative as implementable, but in Tables 1 and 2 it is listed as not acceptable to local/federal authorities. This inconsistency needs to be addressed.

 - Please indicate why SVE with Thermal Desorption was not considered as a preliminary remedial alternative as the qualifiers in each column are identical to SVE with steam injection, which was considered as a preliminary remedial alternative.

- Please add a Table 4 to list the preliminary remedial alternatives for lead.

19. **Section 8.0 - Surviving Process Options, Page 28 -** The list of surviving process options seems to be missing.

20. **Section 8.1.1 - Alternative 1: No Action, Page 30 -** No Action was not a surviving Process Option as presented in Table 3. However, a No Action alternative is required to be developed under CERCLA protocols. Some statement should be added to clarify to the reader as to why this is still an alternative even though it was eliminated in Table 3.

21. **Section 8.1.1 - Alternative 1: No Action, Page 30 -** The paragraph titled "Time" includes discussion regarding degradation of TCE and PCE over time, however, there is no mention of lead in this discussion. Please add a description or another section that details the time for lead attenuation.

22. **Section 8.1.2 - Alternative 2: Monitored Natural Attenuation, Institutional Controls and Engineering Controls, Page 31 -** In order to include Institutional Controls as a surviving Process Option in Section 8, they should be screened as a Process Option as presented in Table 3. Please either remove the reference to Institutional Controls in this section or add them to the screening process.

23. **Section 8.1.2.1 - Alternative 2: Monitored Natural Attenuation, Page 31 -** It is stated that the Klockner property is an ideal candidate for monitored attenuation based on the low potential for chemical migration. As the primary objective is to prevent impact to groundwater from soil contamination, monitored natural attenuation does not appear to be a desired alternative. In addition, lead does not naturally attenuate unless dilution due to migration is considered, which again does not support natural attenuation as a desired alternative.

24. **Section 8.1.2.3 - Alternative 2: Engineering Controls, first paragraph, Page 32 -** This paragraph states that the advantages to using an engineering control (i.e., cap) as a desired alternative. It states that a cap would restrict infiltration of water through the soil and would, therefore, restrict the movement of contaminants through the soil and into the groundwater. However, there is no mention made regarding the ability for groundwater elevations to fluctuate which would allow contaminant migration to occur through direct contact with groundwater, thus making this alternative less desirable than other alternatives.

25. **Section 8.1.2.3 - Alternative 2: Engineering Controls, third paragraph, Page 31** - Please add "for TCE and PCE" between "standard" and "would" in the third sentence. In addition, please revise the last sentence to reflect that the cleanup horizon for this alternative would be similar or longer than the monitored natural attenuation and somewhat longer than the active remediation alternatives.

26. **Section 8.1.3 - Alternative 3: Excavation - On or Off Site Treatment, Pages 32 and 33 -**

    - The four waste management Process Options that are presented in tandem with excavation were not screened as Process Options as presented in Table 3.

    - This section states that excavation is not viable because it would result in disruption of business. If that is correct, then excavation should not be a surviving Process Option as presented in Table 3.

    - Excavation could also be staged to reduce the impact to business operations.

    - There should be an additional section that addresses partial excavation for the exterior lead contaminated area, so that it is clear that partial excavation is a viable alternative.

27. **Section 8.1.4.1 - In Situ Chemical Treatment, Page 33** - In-situ chemical treatment was not a surviving Process Option as presented in Table 3.

28. **Section 8.1.5 - Soil Vapor Extraction, Page 34** - If soil vapor extraction methods are utilized for sub-slab remediation at the Klockner site, this section should address methods to ensure that "clayey silty soils" (low permeability soils) will be treated effectively and that pore air flow will not simply bypass around these soils and through adjacent higher permeability soils during in-situ treatment.

29. **Section 9.0 - Conclusion, Pages 34 and 35** - The first paragraph includes incorrect statements regarding the survival of initial screening. This paragraph, combined with the previous inconsistent use of terminology and the previous inconsistent evaluation and screening results, does not provide a clearly defined path to the selection of "the most viable options for the Klockner Property." For instance, there does not seem to be enough supporting documentation to make an informed decision on a viable remedial option for lead. However, the options as stated in the conclusion section may be appropriate.

307292

In accordance with Section VIII, paragraph 35 of the Administrative Order on Consent, an amended Technical Memorandum is due 30 days after receipt of this letter.

Should you have any questions or comments on any of the above, please contact Brian Quinn, of my staff, at 212-637-4381.

Sincerely yours,

Carole Peters

Carole Petersen, Chief
New Jersey Remediation Branch

cc: David L. Isabel, Riker, Danzig, Scherer, Hyland & Perretti, w/encl.
Donna Gaffigan, NJDEP, w/encl.

307293